INDIAN FARMING

ISSUED BY
THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

Vol. II : No. 1
JANUARY 1941

Subscription : Rs. 6 per annum : 8 as. per copy

PUBLISHED BY MANAGER OF PUBLICATIONS, DELHI
PRINTED BY MANAGER, GOVERNMENT OF INDIA PRESS, CALCUTTA

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Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Imperial Council of Agricultural Research, Imperial Secretariat, New Delhi.

The subscription is Rs. 6 per annum, 8 as. per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertisements should be made to the Manager of Publications, Civil Lines, Delhi.

Subscribers in Europe and America should apply to the High Commissioner for India, Public Department (Publication Branch), India House, Aldwych, London, W.C. 2.

preferable to the cinema, which passes too quickly for the ordinary villager to assimilate. It is also proposed that the Imperial Council of Agricultural Research should bring out a series of well-illustrated booklets dealing with the care and development of each class of animal for distribution amongst cultivators and stock-owners.

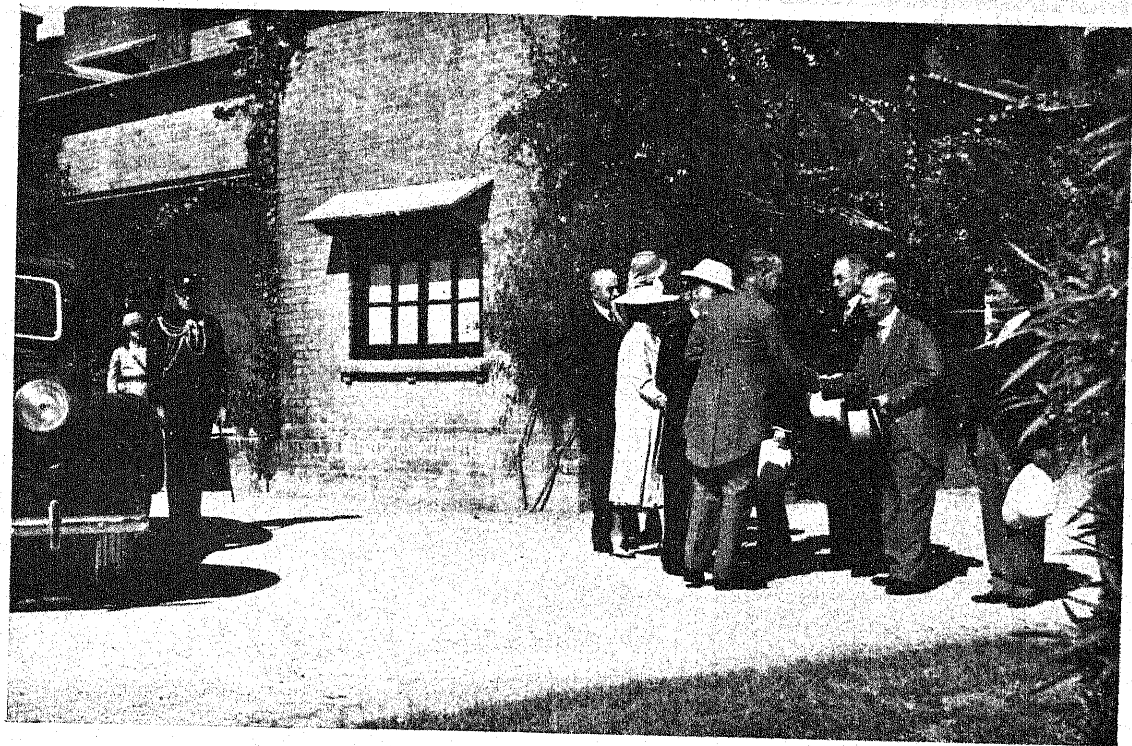
Another item of great importance on the agenda was that relating to the introduction of legislative measures for the control of contagious diseases amongst cattle in India and a recommendation was made that this should now be done in all provinces and states. The time has passed when a Central measure on this subject can be introduced, but the Government of India are concerned with the importation of diseased animals through the ports and for the control of inter-provincial and state traffic in diseased animals, but until provinces and states have taken steps to put their own house in order in this matter, it is difficult for the Central Government to devise suitable measures for inter-provincial control.

Several technical subjects, such as the control of mastitis and rinderpest in cattle, worm infection in sheep and goats, sterility in cattle due to Bang's disease and other causes, and nasal granuloma were discussed and our knowledge in regard to these considerably advanced, while industrial subjects such as sheep-breeding, poultry farming, and the damage caused to the hides and skins trade by the warble-fly and other animal pests were also included. Of these perhaps sheep-breeding and the policy to be followed by breeders in future in order to supply the demands of the Indian and export markets excited the most discussion and it was pointed out that the first requirement is a survey of the different breeds of sheep in India and a description of their potentialities as wool producers. The necessity for the establishment of a Central Wool Research Station which would deal with the many fundamental subjects requiring attention in connection with this industry was also discussed. Such a station would provide a guiding and correlating organization at the centre, in the same way as the dairying and poultry industries have now been provided for in this respect by the Government of India.

Such then is a brief survey of the work done at this meeting, and one can only express the hope that both our research and field workers in the realm of animal husbandry will have acquired some new knowledge or been imbued with some new ideas which will lead to further progress being made in this subject. Admittedly the progress that is being made is slow, but this is inherent in a problem of such magnitude as that of livestock improvement in India. However, with the opportunity for interchange of views and pooling of experience, which is given periodically at such meetings as that which has just passed, we may rest content that it is sure.

FOURTH ALL-INDIA CATTLE SHOW

The fourth All-India Cattle Show will be held at Delhi from the 17th to the 22nd February 1941. This year six additional breeds are included, also two new championships, a student-judging contest, milk and milking competitions. In conjunction with the exhibition of cattle a poultry show representative of all India is to be held from the 17th to the 19th February. Prospectuses for both can be had from the Secretary, All-India Cattle Show, Irwin Amphitheatre, New Delhi. The prizes to be given away this year will exceed Rs. 20,500.

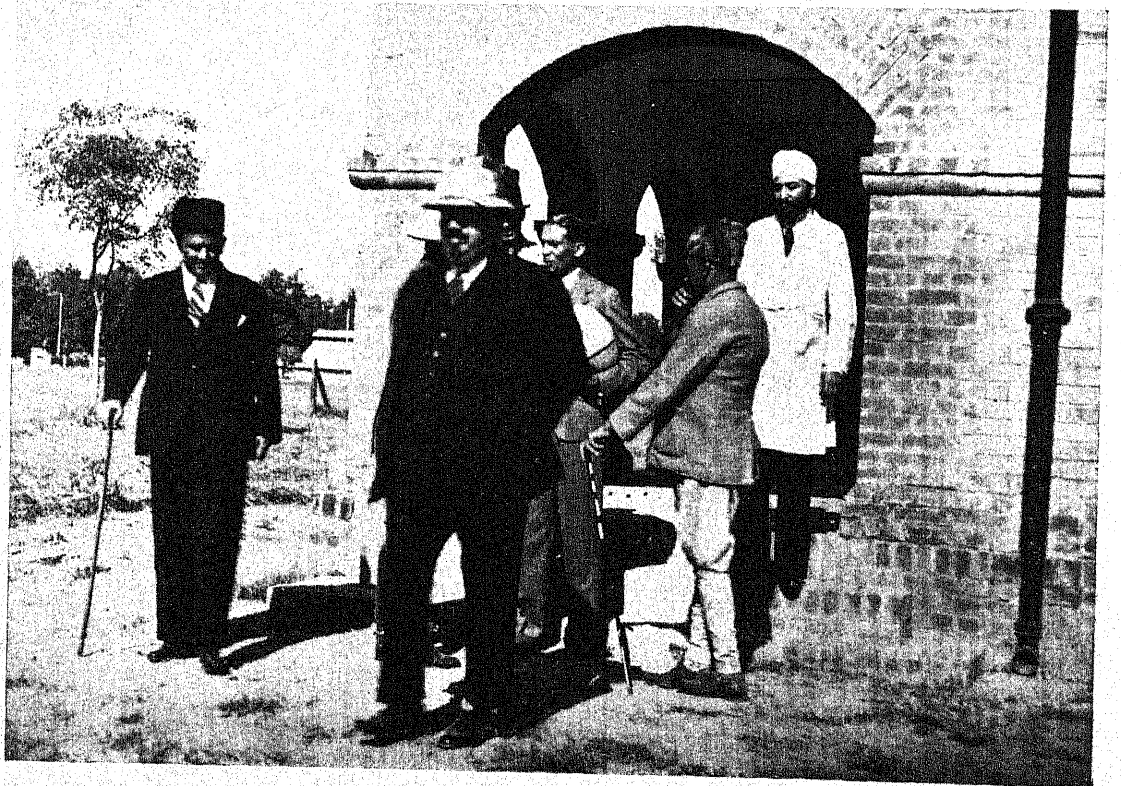


H. E. the Governor and Lady Hallett being received by Dr F. C. Minett, Director, Imperial Veterinary Research Institute

Mr P. M. Kharegat, Vice-Chairman, Imperial Council of Agricultural Research, reading the address

[PLATE 1

Visitors being shown around the Imperial Veterinary Research Institute laboratories



Visitors leaving a laboratory

Original Articles

PLANNING FOR RURAL MARKETING

By VAIKUNTH L. MEHTA
Managing Director, Bombay Provincial Cooperative Bank, Ltd., Bombay

THE range of requirements to be met by any planning in the field of rural marketing for the country as a whole is so vast that no scheme can, in practice, comprehend all these diverse needs. At one end of the scale we have the petty peasant or tenant raising some inferior kind of food grain on a tiny plot of land and at the other we have large landlords cultivating huge estates and raising crops on a commercial scale. For the bulk of the agricultural population, however, it would be true to assert that they buy in the dearest market and sell in the cheapest, whereas the aim of every economic organization is to buy in the cheapest and to sell in the dearest market. The individual cultivator is ordinarily unorganized for business purposes and hence the business operations of millions of individuals are carried on by them as isolated units. Naturally, therefore, economic interests that are slightly better organized are able to take advantage of the economic weakness of these individuals and this happens to the operations of supply as well as marketing.

No progress without education

Planning in other fields will affect the place of the individual producer in the economic structure; but it is necessary to draw up a plan which may fit in with the agrarian conditions of today, provided certain adjustments are carried out and some regulatory action taken by the state. Even then, not much progress is possible unless individuals get the necessary rudiments of education which alone can prepare their minds for education in business and for training in organized effort for common aims. The diffusion of general education as the basis for training in business methods and corporate action is an essential requisite of progress in this as in other aspects of national life.

Despite favourable conditions, it is often seen from experience that individuals who appreciate the benefits of organized marketing cannot take advantage of the facilities that may be made available by reason of their indebted condition. An indebted agriculturist is often not a free agent in the matter of selling his produce, and in many parts of the country the village moneylender is also a trader through whom supplies are purchased and produce is sold. Before marketing can be organized it is necessary, therefore, that the burden of debt should be eased. It has to be emphasized, however, that while the individual agriculturist will be freed from the domination of an economically stronger middleman, he will have to subject himself to a certain degree of discipline exercised either by the state or by a voluntary cooperative organization of which he is a member. In modern economic life no progress is possible without organization, and organization postulates discipline and mutual control. Those who refuse to subject themselves to the necessary control may have to forgo the advantages expected to accrue from the organization of marketing.

Problem of transport

Before describing in detail the lines on which machinery for the sale of the agriculturist's produce should be set up it is necessary to refer to two important factors which have a vital bearing on the organization of marketing. The first is the problem of transport. Leaving apart the larger aspects of the question of transport, reference may be made here only to the need for joining up villages by suitable roads with the highways of traffic, especially those that link them up with the nearest local market-places. Notwithstanding the expenditure incurred on roads in recent times, the condition of the

approach roads in villages shows on the whole little improvement. There are villages in tracts with a heavy rainfall which are practically isolated for three or four months of the year, while there are numerous others that are served by roads full of stones and ruts. Cart traffic is not easy for the purpose of carrying heavy loads, and needless strain is imposed on the bullocks or the carts have to undergo frequent repairs. It is essential that of the large amounts spent on road construction and repairs, substantial sums should be earmarked for the provision of well laid out cart tracks to all villages with a population of 500 and over and the carrying out of repairs on these after the rains, annually. Paved causeways or low level bridges should be provided on the roads connecting villages with their marketing places.

Importance of grading

The second important factor, especially in respect of cash crops, is grading. If individual producers wish to avail themselves of higher prices for quality produce, they will have to accept grading standards for their cash crops. At the same time, by the organization of orderly, well-regulated marketing, steps should be devised to secure higher prices for produce of better quality graded according to recognized standards. To insist on grading and then leave individual producers at the mercy of middlemen is worse than useless. In the existing conditions, grading may be undertaken by officials of departments of Government or recognized public bodies such as market committees. Grading by cooperative institutions may be attempted for special types of commodities when the institutions themselves are well-developed, control a large volume of trade and can regulate production.

The question of grading is connected, to a certain extent, with warehousing. If the produce is properly graded, it has to be stocked in separate godowns pending its disposal. Warehousing arrangements at present are primitive in the sense that there is no attempt made except in the larger *entrepots* for the graded goods to be accommodated separately. Grading can be undertaken by the agency responsible for the provision of godown accommodation for the primary producer. This is possible only where the accommodation is provided by a responsible and reliable agency. Warehousing arrangements may have to be of two types—of the simplest description for food grains and other miscellaneous produce usually marketed and consumed locally and of a somewhat more elaborate type for the main cash crops. The most suitable agencies that can be entrusted with the custody and upkeep of the godowns of the former type are: village panchayats; grain banks; multi-purpose cooperative societies; cooperative purchase and sale organizations; branches of cooperative or other approved agricultural banks.

Government assistance

In the absence of any of these agencies, Government themselves should undertake the responsibility in rural areas, by attaching small godowns to the village *chauras* or *chavadies* and entrusting the management to the village headman and the village accountant. Government should also, as part of their rural development policy, accept responsibility for the provision of cheap long-term loans for the construction of the godowns. The rate of interest should not exceed the average yield on Government securities by 1 per cent or thereabouts and the period of repayment should be 15 to 20 years. Loans should be granted to the various types of agencies referred to above, and, in special circumstances, this form of assistance may be supplemented by the grant of small cash subsidies. This may be necessary in backward areas where the income from the rent charged on the storing of inferior and low-priced varieties of food grains may not bring in an adequate income. Warehousing accommodation is available in the larger market towns but is not always satisfactory from the point of view of the primary producer. The bulk of it is controlled by the middlemen or by the concerns engaged in the work of processing. Market committees, where established, should be encouraged to provide such accommodation as part of their legitimate duties and for this purpose they may look up to Government for funds in case they have no long-term resources of their own. Similar assistance

should be extended to cooperative sale organizations operating over wide areas either on a single commodity or on a general basis.

Market legislation

One of the first steps in the development of marketing in the interest of the primary producer is the enactment of legislation for the regulation of markets. Such legislation should embrace the various points dealt with in the recommendations made on the subject by the Royal Commission on Agriculture in India. The most important of these points are :

(1) the constitution of the market committees so as to secure adequate and effective representation for the interests of the primary producers ;
(2) the regulation of market charges and the prohibition or restriction of miscellaneous levies ;
(3) the provision of an impartial and expeditious machinery for the settlement of disputes ;
(4) the provision of storage accommodation ;
(5) the efficient control of weights and measures.

As observed at the outset, the primary producer in several parts of the country has no contacts with the larger markets such as are likely to be served by market committees. Sales in fairly large quantities take place on the fields, at the farmsteads or on the roadside and at weekly bazaars. The latter is the common method of sale adopted by the very small producer. The main defects of local sales are :

(1) the possibility of lower prices being offered, taking advantage of the ignorance and need of the seller ;
(2) the use of defective weights and measures ;
(3) the deferring of payment and occasional failure to pay.

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It is necessary and possible to insist on the use of certified weights and measures and also to take stringent action in case of default in payment. Market committees may entertain complaints from rural areas from which produce is ordinarily drawn by them and may be empowered to take action on complaints. Their task will be facilitated with the progress of education and the growth of public opinion. The same forces alone can check abuses arising from point (1) above. It will be the duty of the market committees to diffuse, in the best manner possible, information about the market rates for various commodities. They may have correspondents or representatives in the surrounding villages who may be kept posted from day to day about the changes in the market rates and conditions.

Moneylender and middleman

The more backward the condition of the peasantry the greater the extent of the hold of the moneylender and the middleman over the primary producer. The disadvantage to the seller tends to diminish with improvements in communications, with the spread of education and with the supply of regular information about market rates. Although in normal times and in normal tracts the cultivator's indebtedness may not adversely affect his ability satisfactorily to market his goods or curtail his freedom in that respect, the position of cultivators in areas such as those designated as 'excluded' or 'partially excluded' is much worse. The peasants are not free agents ordinarily in the matter of the sale of their crops and their credit transactions with their moneylenders are intermixed, to the advantage of the latter, with the supply of goods and the sale of produce.

It is necessary effectively to control these operations, firstly, by bringing the moneylenders' transactions under the scope of suitable legislation for debt relief and for the regulation of accounts. Secondly, there should be machinery for the provision of credit through a responsible agency either cooperative or state-controlled which can arrange to pool the produce and to dispose of it profitably and which can supply domestic and other requirements on a cost-price basis.

Cooperative marketing

In a country of small holdings and small individual agriculturists the most suitable form of organization for the purpose of marketing is cooperative. The state will not itself organize and conduct marketing operations

but will provide facilities and exercise control. The cooperative marketing organizations may be of the following types:

(1) village or group multi-purpose societies;

(2) purchase and sale societies for the smaller local markets;

(3) central marketing societies for larger areas serving central markets and preferably on a commodity basis;

(4) a provincial wholesale society.

The village or group multi-purpose societies can help mainly to collect produce and to supervise local storage and petty local sales. Usually, they will act as feeders to the society operating in the local market, though they may, on their own responsibility, transact local sales on a purely commission basis. This agency is particularly helpful, however, in controlling credit, supervising local storage, assisting in the elementary stages of grading, transporting the locally collected produce, stocking seed, serving as a grain bank or manure depot, and functioning as an agency for the collection of indents for seeds, manures, etc. and for the distribution of the goods when received. If joint marketing is to be organized effectively through this agency, it is necessary that there should be some degree of compulsion. This should be limited to those who join as members to the extent that it is necessary for them to discharge their liabilities to the societies or to other recognized creditors such as land mortgage banks. There may be compulsion beyond that stage voluntarily accepted but not enforced by the law as in South Africa or other countries. Compulsion in the matter of membership may be enforced in later stages only where special varieties of crops are grown which require proper control in the matter of marketing.

Local purchase and sale societies

The local purchase and sale societies will have more direct responsibility for the work of marketing. They should have a compact area of operations covering one or two talukas (*tehsils*) with homogeneous agricultural conditions. They should undertake the sale of the principal crops of the areas served by them. Their membership should be open to individual agriculturists and to cooperative societies. To ensure better prices for the produce sold by the growers the societies should arrange, so far as possible, for the local processing, preferably by hand, of the products. They should, as previously observed, arrange for the grading and, if possible, for the pooling of the produce before sale. The pooled produce may be sold at short intervals and a system of averaging the resultant prices should be evolved after experience.

Reference has been made to the provision of godown facilities through these societies. They may provide finance against the produce in their possession, they may stock improved seed, implements, manures, and they may purchase other articles against indents. Their main function, however, should be the sale in the most efficient manner possible of the produce entrusted to their charge, either locally or in consuming centres. Where special commodity or provincial marketing societies are in existence the local societies will arrange for sale to wholesalers through such organizations. The need for maintaining detailed and elaborate accounts and for keeping a reliable and responsible staff demands a scale of expenditure which, in the initial stages, is a little difficult to meet out of income from the custom that is in process of being built up. For this reason, it is necessary that Government should grant small subsidies to these bodies to the extent of Rs. 500 or so per annum for three to five years, provided half the deficit is borne by the organizations themselves. If the organizations establish branches they may be allowed subsidies on a lower scale limited to Rs. 250 or so per year for each such branch.

Central societies

The central marketing societies will have a wider area of operation which may extend to the whole of a region or a province. They may preferably be on a commodity basis, the commodities being cash crops such as cotton, jute, tobacco, groundnut, paddy or *gur* or fruits and vegetables or articles like eggs and ghee. If the resources of the societies are substantial and they can cover the risks involved in purchase and sale transactions owing to fluctuation

in prices by the adoption of safeguards under expert advice they may themselves gradually assume such risks on a limited scale as they gather experience. Apart from this, the main function of the societies will be to place the local organizations in touch with consuming centres and with wholesale dealers and to provide systematic arrangements for processing, grading, storage, packing and sale. Individuals will ordinarily deal with these bodies through their local sale societies, but the overhead charges should not be increased on that account. The societies should have substantial share capital and where the organization is of importance from the public point of view, Government may participate by contributing to the share capital or making available a guarantee fund. Before doing so Government may prescribe terms such as will make their control effective and ensure the conduct of the organization on sound lines.

Similar assistance may have to be extended to a provincial society if one is to be established to assist in the sale, on a provincial basis or at the provincial headquarters, of miscellaneous varieties of products which may not be marketed through special crop or commodity societies. The lines of working of the provincial organization should be the same as those of the central agencies referred to above, with this important modification that as it deals with a number of miscellaneous articles it cannot make outright purchases but should act only as a commission agency. Ordered marketing and large-scale pooling can be embarked upon only by well-knit commodity marketing societies commanding substantial resources, possessing a technically qualified staff and acting under expert advice.

WORK ON PUNJAB WHEAT SINCE 1906

By Sir William Roberts, C.I.E., M.L.A.

British Cotton-Growing Association (Punjab), Ltd., Khanewal

The Punjab produces over 50 per cent of the total wheat crop of India. Roughly 50 per cent is irrigated and 50 per cent rain-fed; but the actual Punjab production is probably 65 per cent canal-irrigated land and 35 per cent rain-fed, as irrigated wheat gives at least 25 per cent more yield.

Sir Albert Howard realized early that the Punjab was the most important wheat tract in India and started separating the crop into distinct botanical varieties as early as 1906. He collected samples from various districts and grew them and found 25 distinct types. Punjab No. 9 and 11 were being tried out as early as 1910. The former proved susceptible to rust and not as good a yielder as No. 11. The latter was put out on a large scale by the writer from 1912 onwards. In the meantime, Mr Milne, then Economic Botanist, Lyallpur, conducted wheat field surveys all over the province and he and his successors were able to isolate several new types missed by Sir Albert. These were named after those classified by Howard, e.g. 8A, 8B, etc. and 9A, 9B, 9C, 9D, etc. It is interesting to note that 9D gives excellent results in Kangra district, but has not been successfully introduced owing to the difficulty of raising seed on any scale among the small growers of Kangra district, and the bigger farms in the plains refuse to grow the type owing to its low yield compared to C 518.

New types

One of these new types, viz. 8A, soon showed its superiority in yield to No. 11 and was grown on a large scale by 1919-20. Since then types 518 and 591, which are reputed to be crosses, have been isolated and bred pure, and have been highly successful. These were put out in 1933-34 respectively. Type 518 is suitable for good conditions, whereas 591 does best on average soil and growing conditions and has a grain much valued for baking purposes. These two crosses were produced by R. B. Ramdhan Singh, the Cerealist at Lyallpur.

Mr Stewart, the present Director of Agriculture, states: 'C 591 was produced from 8B × Punjab 9 as parents and C 518 from 8A × Punjab 9. Both of the latest successes therefore have a common parent in Punjab 9. C 591 gets its high quality from Punjab 8B always known to be of excellent quality, but a poorer yielder than 8A. C 518 gets its yield qualities from Punjab 8A.'

Last year the Agricultural Department in the Punjab sold seed amounting to 2¼ lakhs of maunds or sufficient for 400,000 acres. Two years ago enough seed for 500,000 acres was sold.

Besides this the large farms such as Coleyana, the Military Farm at Okara, the B. C. G. A., Khanewal, and others distributed seed both in the Punjab and Bahawalpur particularly, and also in Sind to some extent. In Bahawalpur alone seed for 60,000 acres of improved types from Khanewal was sold last year, through the push and drive of the Revenue Minister, Mr Anderson. Results were excellent and the good work is progressing. At a conservative estimate there must be three million acres of C 518 and C 591 grown pure in the Punjab and Bahawalpur.

Progress in purity

When the writer first came to the Punjab in 1909 an average wheat field consisted of six or seven varieties at least—some bearded and some otherwise. It was rare to see a field that was even 60 per cent pure. It stands to reason that all these could not yield equally. Nor was the mixture uniform or regular, for many fields would contain 70 per cent beardless types and 30 per cent bearded and others

70 per cent bearded and 30 per cent beardless even in adjoining villages. All this has disappeared and Punjab wheat now looks to the uninitiated all uniform and of one type, though careful analysis will show impurities, unless the seed has been obtained from a reliable source.

Again, in 1909 wheat in the canal colonies used to contain from 3 to 5 per cent of barley. It is rare to find now even ½ per cent barley in the canal colonies. In tracts such as Ferozepur a mixture is still common and is based on sound agricultural practice.

A detailed survey taking say three straight lines in each *tehsil* and only doing actual wheat fields crossed would now give very interesting results and would show how near the province is to growing unmixed seed and where more work is required in increasing the percentage of purity. The Cerealist at Lyallpur has one or two very promising crosses which are said to yield even better than No. 591—though probably inferior to C 518 in good soils. These will no doubt be shortly on the market.

Improvements in cultivation

Here our record is not so good, for the great bulk of the Punjab wheat crop is still sown broadcast. There are numerous proverbs advocating line sowing, e.g. *Pora badshah, chatta fakir*—Sowing by drill is a king and broadcasting a beggar. Three-tined hand-operated drills were introduced by the writer in 1918 and have had partial success—many hundreds are still in use. They cost about Rs. 12. A mechanical drill was introduced by Mr Johnson, late Deputy Director, but as it cost over Rs. 40, its success was limited. It is, however, said to be still in demand. Lately, the Director, Mr Stewart, informs me, a one-tined drill has had very encouraging results for cotton sowing, but line sowing for wheat is making very little progress.

For after-cultivation the Bar Harrow introduced by the writer in 1919 as a result of studying a similar implement in Madras has had partial success. These are still manufactured and sold at Lyallpur and are useful in breaking the crust after sowing and in conserving moisture. These cost about Rs. 10, but cannot be said to have been generally adopted.

For pre-cultivation the country plough is mainly used. The furrow-turning plough is used once only and is a factor in keeping down weeds, but it tends to make the surface uneven if unskilfully used, so that the bulk of the ploughings are better given with the country plough. The use of the iron plough, particularly the Hindustan, is, however, increasing. One manufacturer in a Ferozepur village is reputed to have made and sold 900 at a cost of Rs. 6.

Weeds

The wheat crop suffers from a number of weed-competitors, the worst being perhaps *piazi* (*Asphodelus fistulosus* Linn.). Next to that comes *lehli* (*Convolvulus arvensis* Linn.) the eradication of which is very troublesome. Other important weeds are *bathu* (*Chenopodium album* Linn.). This is used to some extent as '*sag*' (i.e. as a green vegetables) and will be kept in check by the women for that reason.

Pohli (*Carthamus oxyacantha* Bieb) is another serious weed in wheat fields and is a grave pest in some tracts. The elimination of weeds has not received the scientific study it deserves. Weeds cause an enormous loss to the provincial wheat supply every year.

Smut

The Department of Agriculture's chief success with regard to diseases is in the eradication of smut. The remedy is simple. Seed is soaked in water in June for two or three hours and then exposed to the sun and dried and stored. The resulting crop is almost 100 per cent free of disease. It is interesting to note that in hill tracts such as Simla, Kangra, Kulu, etc., where wheat ripens later, sometimes after the end of June, the treatment is ineffective. The sun's rays in July and August are not powerful enough to kill the spores. Every farmer in the Punjab plains should adopt this smut preventive remedy discovered by R. S. Jai Chand Luthre of the Lyallpur Agricultural College as a regular routine.

COMMON DISEASES OF POULTRY IN INDIA—I

By J. F. Shirlaw, M.R.C.V.S.
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INDIA is just awakening to the potential national value of a properly conducted poultry industry and is, therefore, endeavouring to promote intensive poultry production. But Indian poultry keepers are finding, as have others the world over, that the development of this industry is seriously hampered by disease.

Until very recent times, poultry epizootics in this country did not receive the attention that their importance deserved. At the present day, however, veterinary research workers are devoting much time to the task of solving these problems, since, until some measure of control is evolved, poultry owners must, from time to time, be subjected to such a heavy financial loss that poultry keeping on a large scale must prove an uneconomic proposition.

There are two types of disease with which the poultry keeper must contend, diseases of an infectious character and diseases consequent upon errors of management. It is proposed in this paper to deal only with diseases falling within the first of these categories and, even here, only with those of paramount importance to India. It must, however, be pointed out that errors in management, breeding and feeding, and an inadequate application of poultry hygiene may render fowls highly susceptible to germ-borne and other diseases and that, for this reason, the fundamental preliminary for controlling epidemics is a proper knowledge of these matters.

It should also be borne in mind that it is generally uneconomic to treat individual fowls; indeed, sick birds, unlike mammals, do not as a rule respond well to treatment. The problem confronting the poultry keeper is, therefore, that of prevention rather than cure.

This paper is, however, not concerned with questions of prevention and control but is intended merely to indicate which are the most common diseases with which the poultry keeper in India may expect to have to contend; and so to describe them that he may recognize early an outbreak of any one of them in his flock and thus be able to put into operation measures for its control before the epidemic has got out of hand.

Fowl pox

Fowl pox is a widespread, highly contagious disease, particularly affecting young stock, and, unless strict sanitation is observed, may be the source of considerable trouble to owners in spring and autumn by decreasing egg production at a season when eggs fetch a high price. Bird pox, chicken pox, contagious epithelioma, roup, diphtheritic roup, avian diphtheria and canker are other names by which this infection is known. It is due to a pathogenic (disease-producing) micro-organism, so small that it cannot be seen under a microscope and can pass through the finest bacteriological filter. The natural method of spread is considered to be by means of wounds infected by pecking and fighting, or other mechanical means. The mosquito and certain kinds of blood-sucking flies have also been shown to be capable of transmitting the disease after feeding on an infected comb.

Symptoms.—The period of incubation after infection is from three to twelve days depending on the susceptibility of individual birds. The first signs of the disease are small red pimples which appear on the comb, around the eyes, upon the wattles, upon the thinly feathered parts of the head and occasionally, in severe infections, upon the skin of the body. (These must not, however, be confused with mosquito bites.) The pimple develops into rough, yellow, wart-like nodules, which tend to join together into cauliflower-like masses. The nodules vary in size from a pin head to the size of a pea and contain a small quantity of whitish fluid which is rich in the disease-producing organism. Later, these nodules erupt

on the surface and it is this condition which is often called 'sore head'. As the nodules heal, they appear as dark, and later as black, scab-like masses. Finally the scab drops off, leaving a scar. These symptoms may be accompanied by a watery discharge from the nose, which gradually becomes purulent and may entirely obstruct the nasal passage. At the same time, a yellow, sticky discharge from the eyes will be noted. The eyes will become inflamed, the eyelids will be swollen and tend to become stuck together by the discharge. This condition is commonly called 'roup'. Examination of the mouth may disclose false membranes of a white to pale yellow colour, which, on removal, will leave the underlying tissue raw and inflamed ('canker'). One or any combination of these various lesions may be present in one bird or in different birds of the flock, but, in India, they are all caused by the same organism. The disease usually lasts for from three to six weeks, although in partially immune chickens the period is less.

Fowl cholera

Fowl cholera is another highly contagious disease common throughout the poultry world. It is usually acute and rapid in its course and accompanied by high mortality. Chronic cases are, however, sometimes seen. The disease is caused by bacteria of a group known as Pasteurella. The germs are eliminated from the body of diseased fowls in bowel discharge and in saliva, both of which infect the soil, and pollute the drinking water and feed of the flock, thus spreading the disease to healthy birds. Droppings may remain infective for as long as three months. Spread may also occur through contact with infected birds and with the hands, boots and clothes of attendants. Into healthy flocks, the disease is generally introduced by newly purchased infected birds or by people who have been in contact with infected poultry. Wild birds are also susceptible to the disease and infection may be disseminated by their droppings. Occasionally an outbreak may suddenly occur when there has been no evidence of disease in the neighbourhood and no purchase of new stock. In this instance, the outbreak is probably due to 'carriers' (infected, through apparently healthy birds) in the flock itself and to the disease flaring up, when some external force, such as bad weather conditions, has lowered the resistance of the birds.

Symptoms.—The incubation period is from twelve hours to three or more days. At the beginning of an outbreak, the disease usually assumes a very acute form. The course may, indeed, be so short that birds are found dead under their roosts or in their nests, before any symptoms of illness have been recognized. Later, when the disease becomes less malignant, the first symptoms to be recognized are drowsiness and depression. The sick birds will droop their heads, ruffle their feathers and be disinclined to eat or move. If forced to move, they will stagger in their gait. Their discharge will be profuse and in the early stage will be flaked with red particles. An exceptional thirst is characteristic. Later their temperatures will rise sharply to 109°-112°F. (normal 107·2°F.), there will be signs of ague, their breathing will be laboured and diarrhoea will probably set in. The droppings will be watery, greenish-red or yellow, and foetid and the feathers round the vent will be soiled. It is quite common, also, for the excrement to be blood-stained. The comb and wattles will become bluish-purple and, in most cases, the breast muscles will be darkened. There may be a discharge from the beak and nostrils. Some hours before death, which takes place in from two to four days, complete prostration and coma will set in. Mortality varies from a few birds in a mild outbreak to more than 50 per cent in severe epizootics.

Towards the end of an outbreak the disease becomes milder, and the symptoms may be reduced merely to nasal catarrh or to swelling of one or other of the wattles, with or without diarrhoea. Wattle cases appear to be local infections through wounds. The infection does not spread and the cases normally recover. Chronic cases usually show emaciation, listlessness, anaemia and weakness. They may also evince persistent diarrhoea, and leg and wing joints may be swollen with purulent material, while 'wry neck' may develop if the pathogenic organism attacks the brain.

Fowl cholera should be suspected when a

number of deaths occur among birds after a short illness. An entirely satisfactory diagnosis, however, can only be established by the discovery of the causal organism, and for this blood slides should be made from affected birds and submitted to a competent bacteriologist. Post-mortem examination of carcases of early cases is also desirable for determining the nature of the disease.

Avian tuberculosis

Avian tuberculosis is a disease of great importance to the poultryman, not only on account of losses caused, but also on account of its relation to other domesticated animals, e.g. bovines and ovines. This disease is most commonly found among adult birds and its main danger lies in its insidiousness. The owner may not be aware of its existence among his birds until the flock has become extensively infected and deaths at regular intervals begin to occur. The disease is an especially serious problem on farms where there is a high percentage of old birds, or where unhygienic conditions prevail. Nevertheless, it may cause trouble even on well-conducted farms and among birds of a year or under. In birds, the lungs are rarely affected and the lesions are generally found in the digestive tract, where pearl-like nodules are found on the bowel surfaces and mesentry. Spread, which is rapid, is usually through the ingestion by healthy fowls of food or water contaminated by droppings from diseased birds.

Symptoms.—The symptoms of this disease do not furnish a definite diagnosis. Affected birds will exhibit progressive emaciation in spite of a good appetite. They will gradually become weak and anaemic. At times, diarrhoea is noted. In some cases, lameness, the result of the bacterium attacking the joints, will be evidenced. The feathers will be ruffled and the eyes bright. When the disease affects the skin, there will be ulcerations or sores, covered with a thick hard crust, whitish in colour. Birds suffering from the disease linger for several weeks or months with continuous loss of weight and decrease in egg production.

These symptoms, however, are common to many diseases, especially in the early stages, and there are no positive external symptoms by which tuberculosis in fowls may be recognized. When, however, odd birds begin to show evidence of unthriftiness and to lose condition (which may be detected best by examination of the breast muscles) and when deaths begin to occur at intervals among these birds, tuberculosis may be suspected and veterinary advice solicited. If the birds are of pedigree stock and of sufficient value, the 'tuberculin' test may be applied. Fowls which pass the test should be shifted to fresh ground and should be retested in a month's time.

Fowl typhoid

Fowl typhoid, a disease of late autumn and early spring, is considered to be common in India. It usually affects adult birds, since young chicks possess a natural immunity, but isolated cases among young stock are not uncommon and, in this instance, the disease is believed to be transmitted through the medium of the egg. In adult birds, infection is acquired through the ingestion of food and water polluted by infected droppings. Some sick birds recover and these usually become 'carriers', and an outbreak can generally be traced to the introduction of fresh stock among which such 'carrier' birds exist. The use of contaminated second-hand houses and appliances, which have not been disinfected, may, however, equally well act as sources of infection.

Symptoms.—The disease may be well established before any symptoms are noticed and it is quite common to find several birds lying dead before any form of sickness among the flock has been observed. In the initial stage of the disease, the birds show signs of dullness, drowsiness and anaemia. There may be a nervous action of the head, a weakness in gait and the passing of watery, greenish excrement with a putrid odour. As the disease progresses, there will be a sharp rise in temperature up to 114° F. and a characteristic sulphur-coloured discharge will be observed. Affected birds will become rapidly emaciated and will, when at ease, sit with their heads and tails down. Gradually they will become completely comatose, lying on their sides with

their heads curved under their breasts. Death may occur without a struggle or in a convulsion. The disease usually lasts for from one to twelve days, but will probably not be apparent until the third or fourth day.

None of the symptoms, save perhaps the sulphur-coloured diarrhoea, is diagnostic and the identity of the disease can only be determined with certainty by the 'agglutination' test.

[*To be continued*]

NEW SUGARCANE VARIETIES IN THE BOMBAY DECCAN

By V. V. Gadgil, B.Ag.

*Recently Principal Agricultural Officer, Sugarcane Research Scheme for the Deccan, Padegaon**

ONE of the objects of the Sugarcane Research Scheme, Padegaon, is to test the suitability of new sugarcane varieties received from Coimbatore, Hebbal (Mysore) and other breeding stations. At the old sugarcane experimental station at Manjri, several varieties were tested and some of these, viz. (1) Manjav, (2) J 213, (3) D 109, (4) HM 89, (5) HM 87, (6) HM 544, etc., were recommended to the cane-growers. But none of them took firm root nor was adopted by the cultivators on a large scale. The main defect of these varieties was that they were harder and so offered more difficulty in *gul*-making. They could not compete with the local variety—Pundia—after some years. During those days there was only one sugar factory (The Belapur Co., Ltd.) which at first grew Pundia, a variety not well suited for sugar-making. The situation, however, greatly improved after the advent of the two canes EK 28 and POJ 2878 during the period 1927 to 1932.

Varieties required

Since the opening of the Sugarcane Research Scheme at Padegaon, a large number of sugarcane varieties has been tested and liberated for trials by the factories and cultivators, according to their varied requirements. There are by now ten sugar factories in the Deccan and their requirements are somewhat different from those of the local cane-growers. The factories require varieties with high sucrose content, heavy-yielding, having an extended period of maturity and, above all, suited to be grown as plant cane, *adsali* (post-seasonal) and October plantings. Among cane-growers, there are two classes whose requirements are also different. The big cultivators owning power-crushing plants can adopt hard cane varieties of high-yielding character and the small cane-growers who have bullock-power mills require soft varieties which will not arrow (or sparsely, if at all) so that the tops can be utilized as fodder. Both of these require three different types of cane suitable for plant, mid-*adsali* (October planting) and *adsali* (July planting) proper. Besides, the cultivator's canes should be specially suitable for *gul*-making. Keeping all these considerations in view, the Agricultural Department and especially the Sugarcane Research Station, Padegaon, are trying to release varieties which will suit these requirements of sugar factories and cultivators.

Before the establishment of the Sugarcane Research Station at Padegaon, two new varieties of Java canes were introduced, of which EK 28 was the softer and more suitable for *gul*-making. This was considered as a cultivator's cane while the factories had grown both POJ 2878 and EK 28. In course of time, EK 28 appeared to show signs of deterioration in some tracts. Despite these attempts, about 30 to 40 per cent of the cane area still continues under Pundia, which is a favourite cane of the cultivators and unrivalled for its *gul* quality.

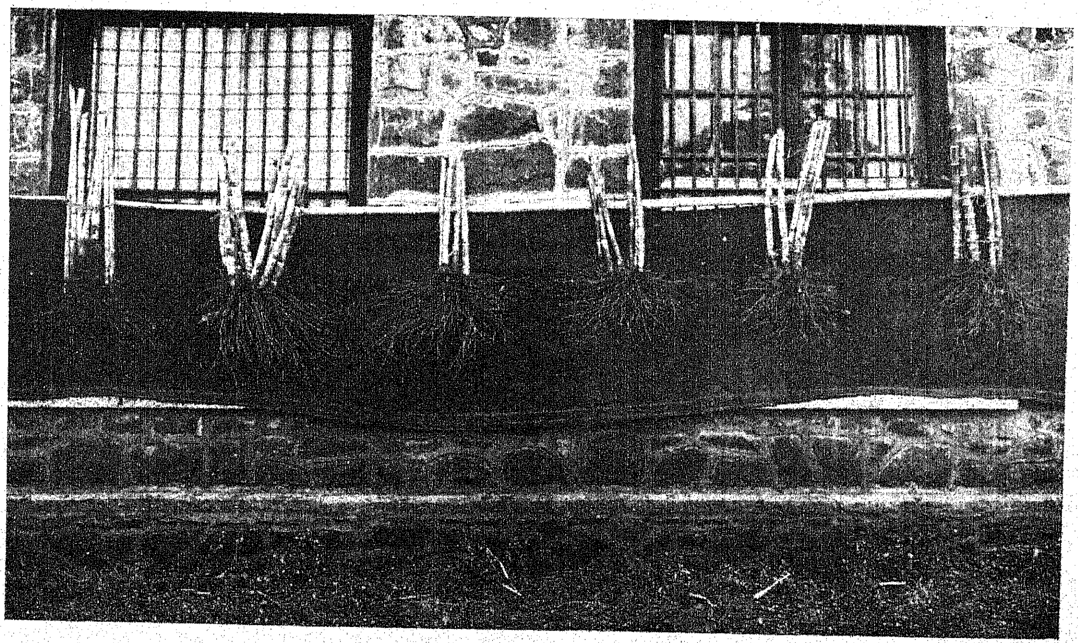
Exhaustive tests

At Padegaon, very exhaustive testing of all the new varieties is done. When the new varieties arrive from Coimbatore and Hebbal (Mysore), they are first tested in rows, to get to know their character, such as thickness or thinness, habit of growth, earliness or lateness, brix, sucrose content, purity, etc., and only promising varieties are taken for preliminary trials in the second year. Promising varieties are further taken up in replicated trials in intermediate or pre-final trials and tested for three years. Very outstanding canes are taken to the final replicated trials even earlier, along with others, and tested for another three

* This scheme is partly subsidized by the Imperial Council of Agricultural Research.

Co360 Co419 Co414 Co417 Co426 HM320

Cultivators' canes

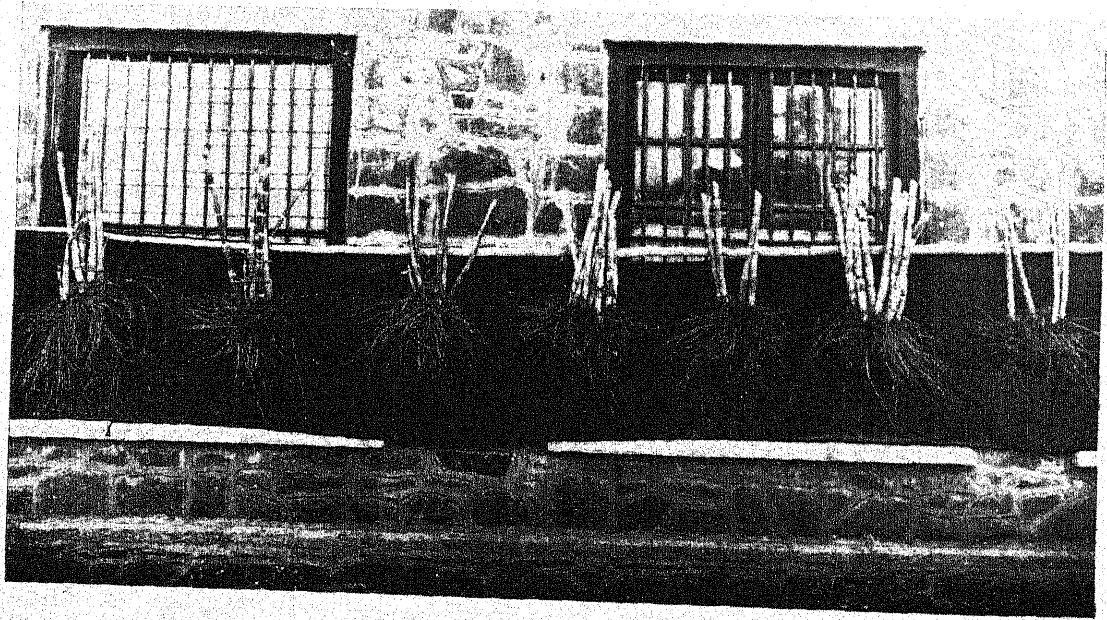


Co360 Co419 Co414 Co417 Co426 HM320

Root system

[PLATE 3

POJ2878 Co407 Co408 Co413 Co414 Co419 Co421
Factory canes



POJ2878 Co407 Co408 Co413 Co414 Co419 Co421
Root system

[PLATE 4

years. Only the best of these are liberated for trials at outside centres.

The second stage of the trial is arranged in factory areas and in cultivators' fields under varied soil and climatic conditions in the canal zones. The genetic soil survey of all the major canals is nearly complete and about nine soil types have been so far identified which will considerably influence the response of different varieties. Thus it will be evident that the fitting of the varieties into these varying conditions is not an easy matter and very exhaustive testing is considered essential at different centres. Besides, as new cane varieties are received year after year, old varieties showing falling off in yields may have to be replaced by new promising ones. In this article, therefore, an attempt is made to describe the varietal work done at Padegaon during the last seven years. The experience of sugar factories and of cultivators is recorded separately.

Trials at Padegaon

Out of the 44 Co varieties tested so far, only nine varieties and one out of six HM varieties have been found to be promising. These varieties can be grouped into two classes from the standpoint of their suitability to cultivators or factories:

(1) Cultivators' canes: Co 360, Co 419, Co 414, Co 417, Co 426 and HM 320. (Plate 3).

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(2) Factory canes: Co 407, Co 408, Co 413, Co 414, Co 419 and Co 421. (Plate 4).

These varieties are briefly described below:

(1) *Co 360.*—Cultivators' cane; lodging tendency with a full growth; root system not the best but superior to Pundia and other varieties from the standpoint of absorption of nutrients; mid-late, sheaths adherent and difficult for stripping; flowering sparsely (fluctuating) unlike many other Co varieties which arrow rather freely and are in disfavour on that account; gives almost the same yield of cane and *gul* as POJ 2878 and is superior in yield to both EK 28 and Pundia; ratoons well and gives a superior quality of *gul*.

(2) *HM 320.*—Cultivators' cane, non-flowering, good growth but weak root system, tendency to lodge heavily; late yields higher than POJ 2878, EK 28 and Pundia from the standpoint both of cane and *gul*; gives fair quality of *gul*.

(3) *Co 419.*—Suitable both for factories and cultivators, flowering, mid-late cane; very heavy-yielding from the standpoint of cane and *gul* compared to POJ 2878 and EK 28; satisfactory habit and good performance with *adsali* and October plantings and as a ratoon; gives *gul* of superior quality; performs well in *chopan* (heavy) soil as well.

(4) *Co 413.*—It is more of a factory cane, thin to medium thick, good habit and root system, almost a mid-late cane, flowering, gives higher yields of cane and *gul* than POJ 2878 and Pundia; gives very superior quality of *gul*, expected to show its superiority in places where Co 290 is grown, performs well in *chopan* soil as well.

(5) and (6) *Co 407 and Co 408.*—More suited for the factories, thin to medium thick canes, early to mid-late, flowering, good habit of growth; foliage covers the rows fully in early stages of growth; fair tonnage with January planting and high tonnage with October planting compared to POJ 2878 and EK 28. Co 408—excellent performance as *adsali* planting.

(7) *Co 414.*—Suitable both for factories and cultivators; satisfactory habit, trashing easy, good root system; flowering, early to mid-late cane, yields as much or slightly higher than POJ 2878; good performance with October planting; gives a good quality of *gul*, next to Pundia.

(8) *Co 417.*—More of a cultivator's cane, fair habit of growth, rather fluctuating; comparatively less flowering, mid-late to late; yields as much or slightly higher than POJ 2878; quality of *gul* comparatively inferior to that of Pundia.

(9) *Co 421.*—More of a factory cane, very satisfactory habit of growth, excellent root system, profuse flowering early cane; high fibre-content, gives higher yield of cane and *gul* than POJ 2878 and Pundia; trashing fairly easy; gives fair quality of *gul*; satisfactory performance in *chopan* soil or under indifferent soil conditions.

(10) *Co 426.*—Mostly a cultivator's cane, satisfactory habit, good root system; medium intensity of flowering, mid-late to late cane;

trashing fairly easy; very heavy yielding compared to Pundia and POJ 2878; though not a rich cane, it gives higher sugar yield per acre than POJ 2878 by virtue of its high tonnage; gives a good quality of *gul*, next best to Pundia.

The relative yield performances of these varieties, together with their brix readings (total solid contents of juice corrected according to temperature), sucrose and fibre percentage in the different trials in medium soil, are presented below.

I. *Adsali* (July) planting

One year's data

—	Co 360	Co 407	Co 408	Co 413	Co 419
Cane—tons per acre	55·2	60·3	70·8	60·3	65·7
Brix	17·98	18·67	19·08	18·96	19·83
Sucrose percentage	12·15	12·64	13·67	12·63	12·64
Fibre percentage	12·53	14·92	13·69	12·30	14·69

II. October planting

Three years' average

—	Co 419	Co 413	Co 290	Co 407	Co 408	Co 360	Co 414	POJ 2878	EK 28
Cane—tons per acre	69·3	56·4	56·2	48·5	52·3	47·2	52·9	43·8	33·0
Brix	21·08	20·60	21·18	23·04	21·56	20·14	22·35	22·82	21·14
Sucrose percentage	15·55	15·28	15·19	15·46	15·50	14·18	16·55	16·48	15·79
Fibre percentage	12·39	13·87	14·18	13·41	15·24	13·28	13·03	15·87	12·51

III. January planting

Three years' average

—	Co 360	HM 320	POJ 2878	EK 28	Pundia	Co 419
Cane—tons per acre	39·2	44·5	40·5	32·5	33·7	48·6
Gul—maunds per acre	117·9	123·0	122·2	104·5	102·3	152·2
Brix	20·84	18·88	22·15	20·98	19·46	21·61
Sucrose percentage	16·43	13·58	16·73	16·21	14·84	16·04
Fibre percentage	12·54	13·45	13·77	12·50	10·39	13·86

IV. Ratooning

The varieties Co 419, Co 426, Co 360, Co 417 and Co 421 show better ratooning behaviour compared to POJ 2878 from the standpoint of cane yields. From the standpoint of sugar, Co 419 is the best, and the varieties Co 360, Co 426, Co 417 are slightly better than POJ 2878 or almost equal to it.

V. Varieties suitable for *chopan* (heavy) soil.

The varieties Co 413, Co 419, Co 421 and Co 410 have been found suitable for very deep soils with high sodium content. Yields varying from 34 to 40 tons of cane have been obtained with these varieties.*

Trials at sugar factories

In the Bombay Deccan almost all the sugarcane required for the factories is grown on their own estates and consequently they require early, intermediate and late varieties of cane

* All the trials at Padegaon were made with manuring of 150 lb. of N. per acre which was the recommendation of the old Manjri farm and consequently the yields are low when compared with outturns at outside centres.

for the supply of cane at different times. Similarly, they require different varieties to suit plantings in January, June and October. In all the factory areas, the cane area is restricted to one-third of the cane block and overlapping is allowed only for six to eight months (monsoon and cold weather). Hence the tendency of the factories is to take the maximum out-turn per acre. In many factories, nearly 40 to 50 per cent of the area is under *adsali*, while about 25 per cent is sown in September or October. The plant cane varies from 15 to 20 per cent. Almost all the *adsali* cane is maintained as ratoon for the second (or third) year which also gives a very good yield. When the planting is manipulated like this, the factories can work from 175 to 210 days in a year and get fresh cane every day. The average yield of each factory area depends upon the nature of the soil and also on the dose of top-dressing manure. For instance, the average dose of the Belapur Sugar Co. is about 1 ton of oil-cake and 4 cwt. of sulphate of ammonia for plant cane, $\frac{3}{4}$ ton of oil-cake and 2 cwt. of sulphate of ammonia for ratoon, and it is $1\frac{1}{4}$ tons of cake and 6 cwt. of sulphate of ammonia for *adsali*, all per acre. In the Rawalgaon sugar farm, where soil is light, the average dose of top-dressing is as follows :

Three tons of groundnut-cake and 600 lb. of sulphate of ammonia for plant cane and $3\frac{1}{2}$ tons of groundnut-cake and 800 lb. of sulphate of ammonia for the *adsali* crop, per acre. The yields of different varieties, therefore, depend upon the nature of the soil and the dose of top-dressing.

Average yields of main varieties

(1) The Belapur Co., Ltd., Harigaon

Total average for all crops, i.e. average of *adsali*, plant and ratoon crops	POJ 2878	EK 28	Co 419
1937-38	41·57	35·01	45·65
1938-39	41·66	31·57	52·31
Adsali—			
1938-39	57·20	Not grown	64·14
Plant—			
1937-38	31·22	35·61	41·11
1938-39	30·64	32·33	37·32
Ratoon—			
1938-39	28·31	24·98	29·54

(2) The Maharashtra Sugar Mills, Ltd., Tilaknagar

The Maharashtra Sugar Mills had grown POJ 2878 and Co 419 on a big scale in their estate and the following are the results of their trial for the year 1938-39.

Name of variety	Yield of cane per acre in tons	Brix	Pol.	Purity
Plant—				
POJ 2878	36·0	19·88	17·38	87·39
Co 419	40·0	20·39	18·14	87·46
Adsali—				
POJ 2878	53·5	19·20	17·10	87·10
Co 419	55·0	19·80	18·00	87·20

(3) The Rawalgaon Sugar Farm, Ltd.

At the Rawalgaon Sugar Farm, the following varieties are tried on a large scale and their results for 1938-39 are recorded below. The soils of this farm are mostly lighter decomposed *murum*.

Name of variety	Yield of cane per acre in tons	Brix	Pol.	Purity	Fibre
Co 419—					
Adsali	44·9	18·5	16·6	88·18	12·74
Plant	56·7	15·84	13·73	86·07	12·85
Ratoon	19·20	21·64	19·31	89·22	14·15
Co 290—					
Adsali	55·1	16·98	14·88	87·63	15·03
Plant	38·2	18·06	15·93	88·20	15·91
Ratoon	35·1	19·63	17·39	88·59	11·23
POJ 2878—					
Adsali	56·2	19·14	16·98	88·71	14·99
Plant	35·4	21·71	19·67	90·60	18·41
Ratoon	32·1	23·07	20·18	87·47	21·04
EK 28—					
Adsali	49·4	20·39	18·61	91·27	14·41
Plant	41·9	18·98	16·75	83·25	13·06
Ratoon	31·7	21·17	18·72	91·40	14·37
Co 360—					
Adsali	57·5	18·04	15·81	87·64	13·13
Plant	34·7	18·99	16·94	89·20	15·32
Ratoon	32·9	20·88	19·60	91·00	19·32

(4) The Belvandi Sugar Farm, Ltd.

At the Belvandi Sugar Farm, Co 419 and

POJ 2878 were tried on a large scale and the following are the records for 1938-39.

Name of variety	Yield per acre in tons	Brix	Pol.	Purity
Co 419— *Adsali*	71·6	18·13	15·78	86·99
Mid-*adsali*	53·3	22·58	20·43	90·46
Plant	49·5	23·94	21·62	90·24
POJ 2878— *Adsali*	65·2	19·21	16·74	87·14
Mid-*adsali*	56·1	22·06	20·28	91·94
Plant	45·8	23·56	21·81	92·52

This factory reports an average yield of 51 tons per acre for the whole estate and an average recovery of sugar of 12·25.

(5) The Phaltan Sugar Works, Ltd., Sakharwadi

In the Phaltan Sugar Works, three varieties were tried on a large scale and their yields for 1938-39 are recorded below.

Name of variety	Yield per acre in tons	Sucrose per centage	Brix	Pol.	Purity	Fibre per centage
Co 419—Plant	56	14·75	19·96	18·04	90·36	14·92
Co 413—Plant	22	13·79	19·88	17·61	88·55	16·29
Co 290—Plant	41	75	20·21	17·85	88·30	13·05

(6) Messrs Marsland, Price & Co., Kalamb

In the sugar factory at Kalamb, the following varieties were tried and their yields are given below for the year 1938-39.

Variety	Brix	Pol.	Purity	Tonnage per acre	Fibre in cane
	Adsali (July planting)				
EK 28	17·69	15·69	88·69	60	..
POJ 2878	21·18	19·19	90·59	54	..
Co 290	20·68	19·52	89·54	55	..
Co 419	19·82	17·54	88·49	62	..
Co 413	18·32	16·44	89·73	64	..
	October planting				
Co 419	21·29	19·05	89·95	68	13·75
POJ 2878	21·58	20·20	92·76	52	15·59

(7) The Kopergaon Farm

At the Kopergaon Farm, a sub-station of the Padegaon Sugarcane Research Scheme, the following varieties were tried for the manufacture of *gul* and their yields for 1938-39 are recorded below.

Name of variety	Yield of cane in tons per acre	Brix	Yield of *gul* in lb. per acre
Co 419—Plant	77·6	19·11	19,920
Co 360—Plant	55·2	19·18	14,160
POJ 2878—Plant	56·9	19·87	15,840
EK 28—Plant	47·5	20·81	14,400
Co 413—Plant	70·1	18·19	16,440
Co 290—Plant	59·7	20·37	14,880

From the above statement, it will be seen that Co 419 has given the highest out-turn and the quality of *gul* is also very good. Co 413 is also a good yielder and POJ 2878 stands third in order. EK 28, which was considered as the cultivator's cane, has deteriorated and has given low out-turn.

The new varieties were tried on all the canals and the average results of all the trials for 1938-39 are given below. It is difficult to get the accurate weight of cane, brix, etc. as the final criterion of the cultivator is the out-turn of *gul*.

Name of variety	Yield of *gul* in lb. per acre
EK 28	12,575
POJ 2878	14,322
Co 419	16,989
Pundia	10,132

Conclusions

From the above statements it will be seen that for factory purposes Co 419 is outstandingly good. Next come POJ 2868, Co 417, Co 413 and Co 408. During last season, Co 421 and Co 426 were also found promising but EK 28 and probably Co 290 are lagging behind. Pundia has disappeared from all the factories.

Among the cultivators there are two classes: viz. those who have got power crushers and those who have only bullock power mills. The former have taken full advantage of the new varieties such as Co 419, Co 360, Co 426, Co 421 and HM 320, while among the latter class Pundia is still cultivated. But many of them

have selected EK 28 for preparing *gul*. Thus it can be said that nearly 60 to 70 per cent of the cultivators' area is under new varieties, while only 30 to 40 per cent of the area is still under local Pundia. Gradually they also will adopt the new varieties which can be crushed by the Kamal crusher.

Acknowledgements

The author expresses his sincere thanks to all the sugar factories in the Deccan and also to the staff of the Sugarcane Research Scheme, Padegaon, who have supplied the valuable data of yields of different cane varieties for preparing this note.

GROWING BETTER COTTON IN HYDERABAD

By K. Sawhney, M.Sc.

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Amongst the varieties of cotton grown in the Dominions of His Exalted Highness the Nizam, Hyderabad-Gaorani occupies a prominent place. It is annually planted on about 900,000 acres and its fibre is perhaps the finest amongst the indigenous Indian varieties. However, it is a shy yielder, low in ginning out-turn and difficult of clean picking. In order to remove these defects, Gaorani improvement work was started in 1929 with a handsome subvention from the Indian Central Cotton Committee. The work was concentrated in the first instance on the production of an agriculturally suitable type with high yield, early maturity, drought resistance, high ginning out-turn and a minimum staple length of $\frac{7}{8}$ in. As a result of straight selection work and comparative trials at the Cotton Research Station, the new strain, Gaorani 6, was produced in 1934. During the next three years the new strain was tested in the cultivators' fields of several villages against the local variety, and was found to be the better of the two in most of the trials. Gaorani 6 has originated from a desirable plant that was selected from a cultivator's field in 1929, and it is an improvement over the present variety in yield of seed cotton, ginning out-turn and spinning properties.

Demonstration of new variety

Side by side with comparative tests in the cultivators' fields, numerous demonstration plots of the new variety were set up each year in the tract deemed suited to its growth. Each demonstration plot is half an acre in size and is bounded on either side by a similar plot of the local variety. The crop in the demonstration plots is grown by the cultivators themselves and receives the same treatment as is normally given to the existing variety. The harvesting is done in the presence of the officials of the Agricultural Department and yields are determined both for the improved and local varieties. The extensive cultivation of the improved variety after it has convinced the grower of its superiority to local cotton follows as the natural sequence.

It may be noted that it takes nine years of study and testing before a strain can be finally selected and recommended to the growers for cultivation. This long period is necessary because the rainfall of the Gaorani tract varies greatly in annual amount and seasonal distribution. During the past 11 years, no two seasons have been found similar in the amount or incidence of rain. In the particular case of Gaorani 6, the procedure was shortened by three years due to the pressing need for issuing improved seed to the cultivators at the earliest possible date. It is fortunate that the results have justified this step.

Control of improved seed

Like many other crops, cotton is subject to cross-pollination in the field. Insects visiting open flowers are the chief agents of natural crossing. Left to itself, the purest variety will in course of time develop an appreciable number of 'off type' plants, the existence of which introduces variations in its fibre and other characters and to that extent detracts from its value to the trade. The admixture of seed in the ginning factories and the intentional mixing of *kapas* by the traders are the other potent causes of contamination. The maintenance of a pure supply of seed, expanding gradually from a small plot of 'selfed' seed (i.e. seed obtained from self-fertilized flowers) at the Cotton Research Station to the entire tract growing a particular variety has to be specially worked for. Every year one acre of land at the Government farm is grown from 'selfed' seed obtained from a nucleus plot at the Research Station. The crop in the latter plot is raised from the 'selfed' seed of

Selfing of flowers by fixing wire rings over unopened buds

Ripe bolls developing from 'selfed' flowers

[PLATE 5

FIG. 1. Bags containing pedigree seed of Gaorani 6 Cotton

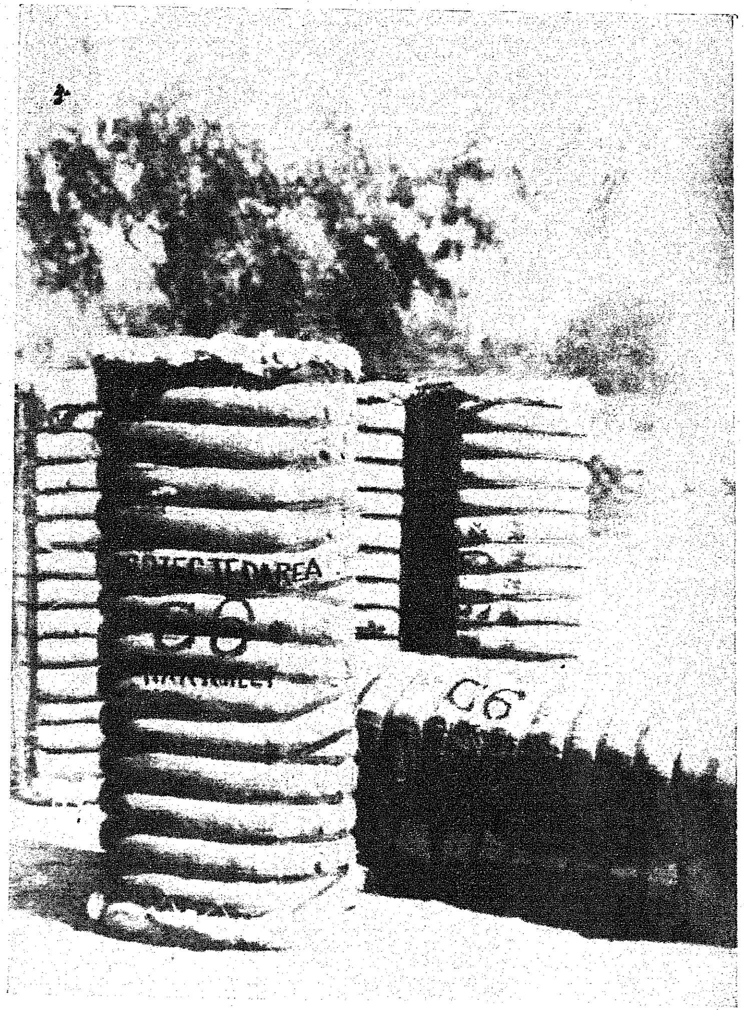

FIG. 2. Bales of Gaorani 6 bearing the Registered Mark

such of the 250 random selected plants as possess the true vegetative, floral, seed, ginning and fibre characters of the variety. The 'selfing' of flowers is done by fixing galvanized iron rings (made from 22 gauge wire) over large-sized unopened flower-buds. The ring is tied to the flower-stalk by cotton thread, so that the boll developing from the selfed flower remains easily recognizable. The rings prevent the opening of the corolla and consequently the access of insects to anthers and stigma.

Seed renewal

The seed obtained from the selfed-seed plot is planted on 15 to 20 acres at the Government farm in the succeeding season. All 'off type' plants are removed from the resulting crop and the entire produce is ginned at the Government farm under strict supervision. The seed from these 20 acres is taken to a selected village, where the annual area planted to cotton is about 200 acres and which is situated near a ginning factory. The sowing of the crop, the disposal of the produce and the ginning of *kapas* (seed cotton) are supervised by the Department of Agriculture. After the *kapas* is ginned, the seed is stocked in bags which are suitably labelled. This seed is distributed in the following year in a compact block of about 2,000 acres and the process is repeated in succeeding seasons in a gradually expanding area. Roguing of the crop in areas reserved for securing planting seed is done by the staff of the Agricultural Department, and contamination of seed in ginneries is avoided by Governmental supervision of the ginning and pressing of the entire produce. The mixing of different varieties is also an offence against the rules framed under the Hyderabad Factories Act for the licensing of ginning and pressing factories.

The area reserved for pure seed in the fifth year is preferably split up into several parts and is located in different places. The splitting up of the 'reserved area' not only facilitates the final extensive distribution of seed, but also lessens the risks of crop failure due to vagaries of rainfall.

The seed renewal method explained above takes nearly five years to supply pedigree seed for about 200,000 acres. The progress in the early stages may be hastened somewhat by raising two crops of 'selfed' seed in the same year. This is possible in Hyderabad State, where frosty weather is virtually absent and Gaorani cotton can be grown both as a *kharif* (autumn harvested) and a *rabi* (spring harvested) crop, and also unirrigated as well as irrigated.

Taccavi system

The control of seed once established continues to work fairly smoothly year after year. It is only in years of extensive failure of crops due to scarcity of rain that a breakdown may be apprehended. However, the results of even this catastrophe may be minimized by growing annually a part of the pedigree seed on a small area under irrigation.

The control of seed-supply is facilitated greatly if the seed is distributed on *taccavi*. In Hyderabad State, the Government purchases every year pure Gaorani seed worth over a lakh of rupees for distribution on *taccavi*. The cost of the seed is paid by the cultivators in a period of three years. The loan is free of interest in the first year and carries six per cent interest in the remaining two. The amounts due on this account are recovered by the Revenue authorities at the time of collection of land revenue.

The control of seed of Gaorani 6 has been exercised in the manner described above. Today, six years after the strain was finally selected for recommendation to the cultivators, the area under it is about 330,000 acres, situated in a compact block.

The Hyderabad Cotton Cultivation and Transport Act empowers the Hyderabad Government to prohibit in a previously notified part of the Gaorani Protected Area the growing of a variety not approved by the Department of Agriculture. This power has not been utilized so far because the new variety has on its own merits proved itself acceptable to cultivators of the area selected for it.

Criterion of success

The ultimate criterion of the success of a new variety is the higher monetary return that it brings to the cultivator. The cash

return is the product of the yield per acre and the price at which the produce is sold. The higher income from the new variety may be due purely to either the higher yield per acre or the higher selling price, or partly to the one and partly to the other. The harvesting of a larger crop than previously from a given area convinces the cultivators readily of the higher yield of the new variety and of the increased cash return on that account. However, the full benefit from the growing of the new variety will not be reaped by the growers until they receive a better price for the improved type. It has already been mentioned that Gaorani 6 is an improvement over the local variety not only in yield but also in ginning out-turn and spinning performance. To secure a higher price to the grower, work for the extension of the improved variety included from the very beginning arrangements for the marketing of Gaorani 6 at a premium over the local cotton, which it was ultimately destined to replace. It was realized at an early stage of this work that the premium for quality, i. e. improved spinning performance, would not be paid to the grower until large and regular supplies of this cotton were forthcoming and until the new variety had earned reputation among the manufacturers. As such, no effort was made for the first four years to secure a premium for its better spinning qualities.

Premium for improved variety

The growers of Gaorani cotton sell their produce generally in the form of *kapas*. The ginning is done at the expense of the merchants or the spinning and weaving mills that purchase the *kapas*. It was considered likely that the purchasers would react favourably towards the price paid to the cultivators if they were convinced of the higher ginning out-turn of the improved variety. Accordingly, in 1936 when the area under the new variety had risen to 4,900 acres, an auction for the fixation of a premium for its entire produce was held by the Department of Agriculture at the beginning of the marketing season. The trade was informed that the improved variety not only had superior spinning performance but also possessed a ginning percentage of 30 as against 27 of the ordinary Gaorani. It was, therefore, suggested that on account of the higher ginning percentage alone the new variety deserved a higher price. This was readily conceded by the trade. The auction brought forth the offer of a premium of O. S. Rs. 5-8 per 480 seers (960 lb.) of the entire seed cotton produce of that season. The cultivator thus benefited not only from the higher yield of the new variety but also from the premium paid for its produce. In the following year nearly 40,000 acres were sown with the improved variety, and an auction for premium was held at the beginning of the marketing season. As a result of this arrangement the whole of the produce of 1937-38 was purchased at a uniform premium of Rs. 5-4 per 960 lb. of *kapas*. The total produce of that season amounted to 4,200 bales and the net increased income earned by the cultivators on account of higher yield and the premium in price was estimated at about a lakh of rupees. The area of Gaorani 6 in 1938-39 increased to about two lakh acres. About 50,000 acres out of this were sown with seed of first to fifth generations and were set apart as a Reserved Area as against the remaining General Area.

Return on cotton research

In a public meeting of growers, merchants and textile interests held in March 1938 at Nanded, it was notified by the Department of Agriculture that the produce of the General Area would be sold in the markets in the same way as the local Gaorani, but the higher ginning out-turn of the improved variety demanded that a higher price was paid for it. On the basis of the previous three years' ginning out-turn figures and the prices paid for local Gaorani, the Department of Agriculture suggested to the trade the fixation of a minimum premium of 9 per cent over the day's rate of ordinary Gaorani. It was pointed out that the suggested premium represented only the price of the extra lint obtained by the buyers of *kapas* and had no relation whatever to the higher spinning performance of the new variety. As a result, the payment of the suggested premium was agreed to by the trade as well as the textile interests. Subsequently, at the beginning of the marketing season, a separate auction for the disposal of the produce of the

Reserved Area was held. The seed from this area was required by the Department of Agriculture for distributing in the succeeding season and the Government had agreed to purchase the seed at a premium of eight annas per 240 seers. On this account the auction for the Reserved Area resulted in an offer of a premium of O. S. Rs. 6-4 per cent over the day's rate for Gaorani 6 from the General Area. Detailed daily records of arrivals of *kapas* and the prices paid for it in comparison with the local variety were maintained for each market. On the basis of the figures thus collected it is estimated that although 1938-39 crop suffered badly from excessive rains and produced only 5,200 bales, the net gain to the cultivators on account of the premium alone amounted to about Rs. 1,23,000. The area under the new variety in the season 1939-40 was estimated at 240,000 acres and the total yield was approximately 40,000 bales of lint. The whole produce was marketed under more or less similar arrangements as described above for 1938-39. The crop of the General Area obtained an average premium of nearly 10 per cent over the price of the local Gaorani, whereas that of the Reserved Area secured a small additional premium over the price paid for the produce of the General Area. It is estimated that on account of the premium alone the cultivators of Gaorani 6 received in this season an extra sum of Rs. 6,00,000. *This additional income is very nearly one and a half times of the total expenditure on cotton research since its inception ten years ago.*

Under the existing marketing system, the ginning percentage of cotton plays an important part in the determination of the price paid to the cotton grower. The relatively little attention paid to this fact hitherto by the plant breeders seems to have worked detrimentally. Not only that the cultivators have not received the increased benefits that were legitimately theirs, but also the valuable aid of the merchant community in the extension work for the improved types has not been forthcoming in many cases.

Guarantee of purity

As stated before, the monetary benefit of any improvement in the spinning qualities of a cotton cannot be realized by the cultivators until large and regular supplies of guaranteed purity are forthcoming. This fact was brought to the notice of the trade as well as the cultivators. It was also brought home to them that the marketing of pure cotton could create a rapid demand for the new variety and, hence, was in the interests of all the parties concerned. To prevent mixing and to guarantee the purity of the produce, the Department of Agriculture undertook to inspect and 'rogue' the standing crops in the field, license petty buyers in villages, control the transport of *kapas* to the markets, supervise ginning and pressing, number every bale, give it a distinctive mark and issue certificates of purity for such bales to the owners. However, it was pointed out that the Department could take up this work provided the trade, including the commission agents, cooperated with the Department by agreeing to provide funds by a voluntary contribution proportionate to their purchases or sales of improved cotton. This condition was accepted by the trade and the rate of contribution was fixed at six annas per hundred rupees transaction for the buyers and two annas per hundred rupees for the commission agents. The entire crop of 1938-39 was marketed under these arrangements. The fund was administered by a mixed committee of officials and non-officials appointed for the purpose by the Government.

Union of interests

For the marketing of Gaorani 6 crop of the 1939-40 season, a Cotton Cooperative Union was established. The Union is a registered body with headquarters at Nanded and branches in other markets. The Union was entrusted with the duty of supervising the daily auction sales, and ginning and pressing of the crop of the General Area. The Union had also been authorized to number the bales, affix a registered Agmark and issue certificates of purity for the marked bales. The Union's funds consist partly of share capital and partly of the amount collected as voluntary contribution from the trade and the commission agents on their transactions in Gaorani 6. The membership of the Union is open to growers, merchants, commission agents and

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textile manufacturers, subject to a restriction of the number of shares held by any one party. It may be noted that in the formation of the Cooperative Union, no interest concerned in the growing, handling or using of the Gaorani 6 cotton has been excluded. The main intention of the extension work done for this cotton is to benefit the cultivator to the utmost, but in all measures taken so far every attempt has been made to secure the willing cooperation of the traders as well as the manufacturers. Antagonism of the latter interests has been scrupulously avoided. It has been found that tact and goodwill always evoke a sympathetic response in the heart of even the most hard-headed businessman.

Another fact that needs stressing is the desirability of the plant breeder taking a keen interest not merely in the botanical improvement of a variety but also in the growing of the new types by the cultivators, and the marketing and disposal of the produce thereafter. A knowledge of the behaviour of the improved strains in large-scale cultivation and the extent to which they succeed or fail in meeting the requirements of the merchants and spinners is invariably of the greatest use to the scientific worker.

THE MILCH COW IN PROFITABLE DAIRYING

By R. L. Tandon, B.Sc. (Hons.), M.Sc. (Tech.)
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DURING the last 20 years much has been said and written about the problem of animal nutrition in India. As a result of researches carried out at various centres, it has been concluded that the conditions of cattle-feeding met with in foreign countries are in many respects different from what we come across in our own.

Buffaloes preferred

India being an agricultural country of small holdings, more attention has been paid to the working bullocks and comparatively little to milch cows. Within his small herd of growing stock, the Indian farmer cares more for the male than for the female calves. As a result of such discrimination, breeds of high milking strains have been neglected in preference to those belonging to the working type. Furthermore, the presence of high-producing she-buffaloes has given an added drive to this process. In the Punjab particularly, the buffalo is the milking animal in the countryside. There is hardly a zemindar in the Punjab villages who does not keep a buffalo or two. The zemindar has found out that unlike milch cows, milch buffaloes can produce, besides the farmer's own requirements, enough saleable surplus milk and ghee which can fetch him immediate cash.

The milch cow, notwithstanding her milk-producing potentialities, has thus been thrown into the background and no thought has been given to proper management and feeding which can improve her productive ability. The usefulness of dairy cows in this country, however, is bound to be appreciated when cattle food of the right type can be provided in sufficient quantities.

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Deterioration of milch breeds

Under village farming conditions in most places in India, the milking animals get some green fodder and some grazing during the year. By far the largest item in the ration, however, is dry roughage like *bhusa* or straw. Besides these, the farmer produces in the course of normal crop production and rotation certain feeds such as cotton-seed, grain, barley, *toria* seed, sarson seed, etc. Some of these seeds and their cakes are available for feeding milch stock. Milking animals are also fed such cooking-house wastes as bread, rice, bran, *chunies* and husk of various cereal grains and pulses. The farmer utilizes all these to the best advantage. But the supply of these articles is limited. To procure an adequate ration for his stock, the farmer must purchase a substantial quantity of feeding stuffs which he can ill afford. Owing to the chronic poverty of the owner, milking cows in India remain for the better part of the year in a state of semi-starvation, and this lack of food has gradually brought about the deterioration of the milch breeds. No amount of research on animal nutrition can change the situation unless the economic status of our farmer is improved.

Useless cattle

Then again there is the vexed problem of the large cattle population of our country. A significant proportion of this population is useless and there is the inevitable wastage of a substantial amount of available foodstuffs to keep this surplus alive. Moreover, the human population of the country is also competing with the cattle for all available lands. The grazing area is thus gradually becoming less and less, which in turn leads to the shortage of fodder crops to support the livestock. If it were possible to dispose of the surplus cattle profitably as is done in countries where beef is eaten, the problem could have been solved. Unfortunately, in India, we cannot progress very far in this

method of disposal. The only course which can be adopted is to limit the growth of the cattle population by systematic castration of scrub bulls.

Apart from the socio-economic aspect of the problem, and purely from the nutritional point of view, it is well known that commonly used Indian cattle feed, especially hays and other dry roughages, are very poor in protein. Most of them are no better than cereal straws, a by-product of cash crops of very questionable nutritive value. Recent researches have, however, shown that better quality hays can be produced by cutting the grasses at a particular stage of growth. Unfortunately, this stage of growth lasts only for a week or two, and it is difficult to muster enough labour during that short period to harvest a large area of grass for hay or silage making. The uncertainty of the weather also contributes an additional difficulty to the proposition.

Extra minerals not needed

The question of supplying additional mineral matter for milk-producing cows has been raised. Fortunately, several large-scale trials carried out on high-yielding cows have shown that provided the animals get sufficient quantity of fodder in the form of a mixture of dried roughage and some leguminous green forage, together with a suitable quantity of a concentrate, no extra mineral mixture need be added to the ration. The lime content of grasses and fodders remains almost constant through the various stages of growth to maturity, and whatever decline the phosphate content may suffer, the phosphate rich grains and cake (in the concentrate allowance of the ration) will always make good the deficiency. Furthermore, if milch cattle can be fed on leguminous fodders like *senji*, lucerne, *gowara*, etc. during the early lactation period, no form of mineral deficiency should be feared.

In conclusion, it may be pointed out that if the scope of dairying in the villages could be enlarged by prohibiting the keeping of milch stock in urban areas, and thus the market for the sale of milk ensured, it is very likely that the farmer will start taking more interest in his stock of milch cows. It is certain that a milch cow can hold her ground against a milch buffalo, as she requires less food for the yield of the same amount of milk. But till such interest is created, the buffalo, because of the high butterfat content (so suitable for ghee making) in her milk, will fare better at the expense of the milch cow.

METHODS OF PROPAGATING FRUIT TREES

By R. S. Dubhashi, B.Ag.
Superintendent, Modibag, Poona

IN spite of the fact that India has a variety of soil and climate suitable for quite a large variety of fruit crops, the import of foreign fruit into India is on the increase mainly because the quality of our fruit is poor. A careful investigation into the causes of the inferiority of our fruit reveals that our present methods of propagating the crops are faulty. Either the stock and scion are not selected and standardized as in the case of the mango and the citrus varieties, or some crops like the guava and the pomegranate are still propagated by seed with the result that our fruits are poor.

Improvement of quality

Long experience of propagation methods in the Deccan has shown that the quality of all our fruits can be improved to a certain extent by adopting the proper methods of propagation. This improvement can be brought about either by legislation or by encouraging the grower to prepare his own plants under all circumstances. It is, however, better that the grower is aquainted with the art of propagating his plants.

Fruit trees can be raised from seed as well as by vegetative methods. Propagation by seed is not considered advisable because the plants do not come true to type. The characters of seedlings split up and the quality of fruit borne by the seedlings varies from plant to plant. The fruit deteriorates in quality and does not remain uniform. The vegetative method of propagation, therefore, is the only reliable method of getting the desired result. The most important vegetative methods are the following:

(1) Propagation by suckers and slips
(2) Propagation by cuttings
(3) Propagation by layering and gootie
(4) Propagation by budding, and
(5) Propagation by grafting.

Propagation by suckers and slips

Propagation by suckers is the easiest of all the methods. This method is adopted in the case of crops like the banana and the pineapple. The best banana suckers are those which are sword-shaped and vigorous. At the time of planting they are headed back to a height of six to eight inches from the bulb and the old roots cleared off. The suckers have to be carefully severed from the parent plant without any damage. The best season for planting in the Deccan is from June to August.

The pineapple is propagated by suckers or slips. Suckers come out from the axils of leaves on the mother plant and slips from the stalk of the fruit below it. Suckers which are about 9 to 12 in. are good for planting. Slips have to be raised in nursery beds and then transplanted. The proper season for planting is from August to October. Experience has shown that the pineapple can thrive only in the Konkan districts.

Propagation by cuttings

This is also a very easy method to follow. It is practised in the case of grape vines and figs. It should be universally practised in the case of pomegranates which are at present propagated by seed.

In the case of figs, cuttings about 8 in. long with short internodes bearing a number of leaf scars are planted in beds. The cuttings are generally planted in beds at the commencement of the monsoon. Figs can be propagated by eye buds also.

Cutting of grape vines are taken from ripe stems after October pruning and planted in beds. The cuttings strike root easily and become available for planting at the end of December. Two such rooted cuttings are planted in each pit so that there may not be any gaps.

Cuttings of pomegranates are planted in beds at the commencement of the monsoon. The cutting is 8 to 10 in. long. Some percentage of the cuttings is not likely to root properly. The present practice of raising

plantations from seedlings is definitely undesirable, as the quality of the fruit deteriorates.

Propagation by layering and gootie

The method of layering is followed in the case of crops such as the guava and the pomelo, whose branches can be bent low near the ground. A mature growing branch is suitably bent and a slit of the shape of a tongue, two inches long, is made towards the growing point. A wedge is inserted in this which is pressed in an earthen pot filled with soil under the pressure of a stone. Layering is generally done in July and August. Watering is attended to regularly in the winter and in the hot season and roots are struck within three to four months after this period. Cuts below the roots so formed are made bit by bit at intervals of 8 to 10 days and the plant separated out at the third cut.

Gootie or marcotting is only a modified form of layering. It is practised in the case of the *chiku,* whose branches it is difficult to bend so low as to reach the ground. A branch of the thickness of a pencil is selected and a strip of bark about two inches long is removed right round. This portion is covered with a ball of mixture of cowdung and earth and tied in gunny cloth and moss if possible. Arrangement has to be made for the dripping of water over this through a string let through an earthen pot which is tied over it and daily filled with water in the winter and in the hot season. The gooties are made generally in the monsoon and it takes 8 to 9 months for the roots to strike. The rooted branch is separated out by making cuts at intervals as in the case of the guava.

Propagation by budding

This type of propagation is adopted in the case of all the citrus varieties and the *Bor*. It consists mainly in transferring the bud of the scion on to a suitable stock and allowing the bud to grow on the latter. For all the citrus varieties, *jamburi* (*citrus limonia*) has been found to be a suitable stock by experiment. The fruits of *jamburi* are collected in October-November, seed extracted and dried, planted out on raised beds and tended for six months or so. The seedlings are transplanted in beds at the commencement of the monsoon. They become fit for budding in October-November. The seedlings to be selected for budding should be vigorous, the rind should be smooth, the bark should separate easily from the wood and the sap should be in a flowing condition. The scion buds are generally selected from the growth of the current season. The bud is removed from the bud-sticks of the tree by slicing it out together with the wood. In the meantime, a normal T or an inverted T cut is made on the stem of the stock seedling about 6-8 inches from the ground. The seedling is slightly bent with the hand, the flaps opened with the budding knife and the bud inserted. This is then tied with banana fibre, leaving the bud free to develop. The top of the stock seedling is headed off after about three weeks, by which time the bud takes. The beds should be stirred frequently, top dressed with fertilizers once or twice and irrigated regularly. The budded plants become ready in about four to five months. This method is known as 'shield' budding, and is the one that is generally practised. This method of propagation is known for the rapidity and ease of operation and cheapness. One man can bud satisfactorily about 150 plants per day, but if the man is a good hand at budding he can do 300 per day.

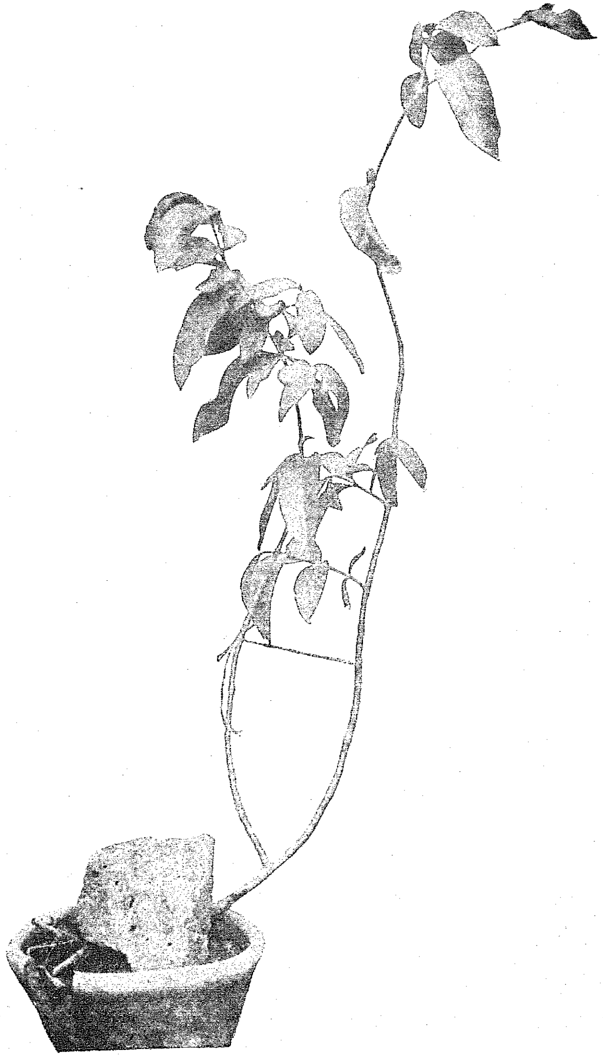
Propagation by grafting

Grafting is also a very important method of propagation of fruit trees. As in the case of budding, a graft is brought about by the union of the stock and the scion. Grafting is practised in the case of crops like the mango, the *chiku* and the guava.

In the case of the mango, stones of country varieties are collected in the months of May and June and planted out in beds. They germinate there and are potted in about three months. Farmyard manure and river soil are put in these earthen pots in order to encourage the healthy growth of the seedlings and watered in the winter and in the hot season. They acquire the thickness of a pencil till the next monsoon, when they become suitable for grafting. A scaffold is constructed round the scion tree so that the branches can be suitably bent. Branches of the growing shoot of the same

A mango graft

A *mosambi* budded plant



A guava layer

[PLATE 7

A Chiku gootie

[PLATE 8

thickness as the stock seedling are selected. Then the bark of both the stock and the scion is sliced off up to the cambium to a length of $1\frac{1}{2}$ to 2 in. so as to fit in well with each other. This is firmly tied round with banana fibre and jute string. The seedlings are watered for about three months after which the union is complete. Cuts are made on the scion branch below the joint at intervals of 8 to 10 days and the branch severed at the time of the third cut. The top of the stock is also headed off. The graft is thus complete and is kept under shade for hardening before planting. This method of grafting is known as the 'Simple approach method' or 'inarching'. One man can prepare 60 to 100 grafts per day according to the dexterity of the man.

There are a few other types of grafting such as the saddle graft, the whip graft, the wedge graft and the crown graft followed under different conditions of the stock, the scion, the soil and the climate, but these methods are not commonly known.

Propagation of fruit trees is a great art. It is not enough if one possesses only a bookish knowledge of the different methods. One should equip oneself with an intimate knowledge of the stock and the scion and the methods appropriate to the particular species. Further, one should have sufficient practice in the particular methods of propagation to be adopted in order to ensure a high degree of success. The instruments required are a grafting knife for grafting purposes, a budding knife for budding purposes and a secateur for taking cuttings, etc. One can attain perfection in the art only by constant practice.

There is still great scope for increase in fruit production in India. It is necessary that every fruit grower must be well versed in the different methods of propagation. He must select the best varieties and raise his stocks so as to have his own nursery for multiplying choice varieties. Then he can increase his income by growing a better quality of fruit. The prosperity of each such grower means ultimately the prosperity of the nation.

What the Scientists are doing

STATISTICS AND RESEARCH

At the request of the Director of Agriculture, Bombay, and with the permission of the Vice-Chairman, Imperial Council of Agricultural Research, Mr S. S. Iyer of the Statistical Section of the Imperial Council of Agricultural Research delivered a series of ten lectures on the application of statistical technique to agricultural experimentation during the refresher course recently held for the officers of the Bombay Agricultural Department at the College of Agriculture, Poona. A special feature of the classes was the daily discussion of several practical difficulties (agricultural and statistical) met with by the research workers in their several fields of work. Such subjects as a proper scheme for rotation experiments, difficulties created by gaps in the stand of crops in an actual field experiment, the study of the resistance to *Striga* attack, etc. were usefully discussed.

The lectures themselves were kept as far as possible free from mathematical symbols and formulæ which usually appear rather formidable to the average agricultural experimenter. Every problem was discussed from the practical point of view. The aim of the lectures was to give a correct idea of the principles and utility of modern statistical methods in the successful carrying out of agricultural field experiments. It was throughout emphasized that statistical technique is a useful tool, and without a sound practical knowledge of the technique, right from the designing of an experiment up to the analysis and interpretation of the results, the experimenter is likely to draw misleading conclusions. At the same time, the workers were warned not to throw the whole responsibility for the ultimate success or failure of an experiment on the statistician. There may be many problems connected with agricultural research where statistics may have no place. Forcing in statistical methods in such cases can only result in bringing the subject itself into disrepute.

These lectures, besides serving to clear difficulties of a type which can only be appreciated by an agricultural experimenter, also provided a forum for mutual discussion and understanding the true role of the statistician in the technique of field experimentation. Such contacts between statisticians and the agricultural research workers are of the greatest value to both.

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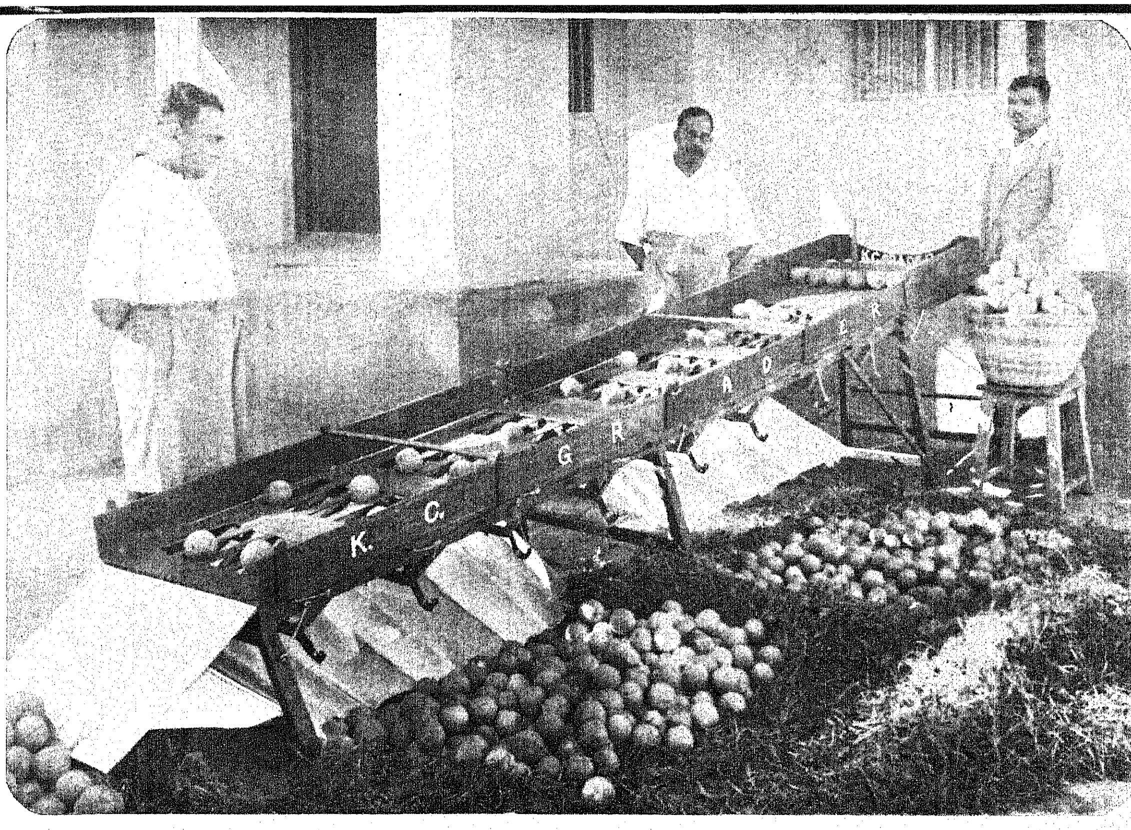
FRUIT RESEARCH STATION, KODUR

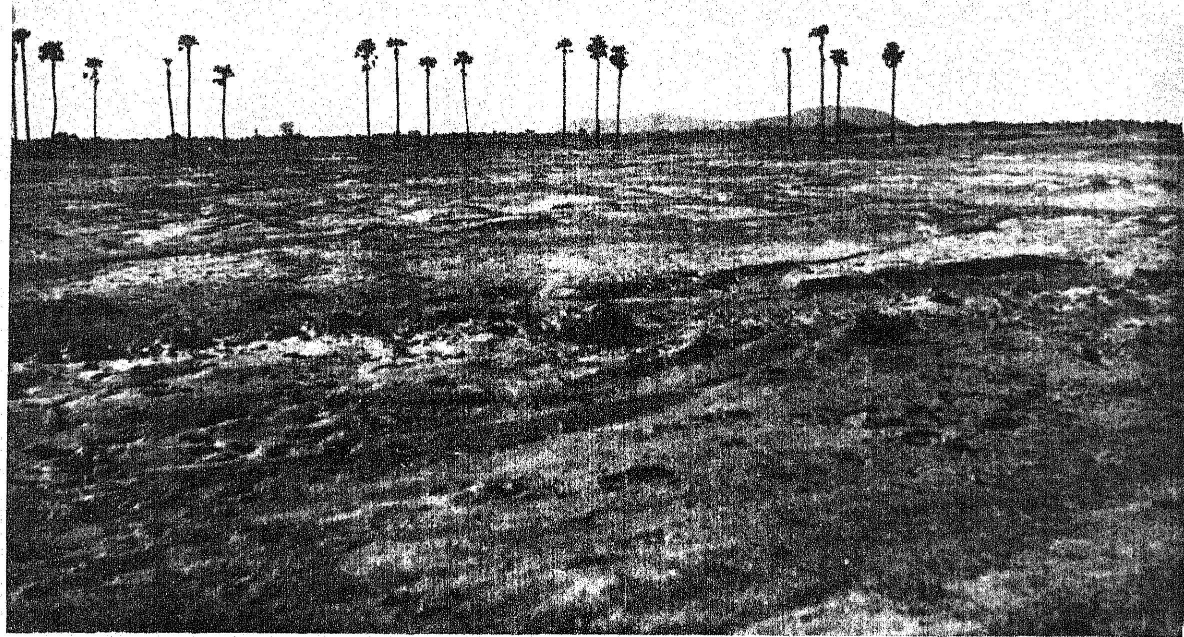
It is well-known that, next to parental influence, the rootstock variety used for budding citrus exerts perhaps the most determining effect on tree performance in the orchard. A series of rootstock trials with sweet orange and acid lime scion varieties are under way at Kodur; and although the final results from these have to be awaited after some years, the data and observations collected up to the first 18 months of orchard life are not without some interest and importance. It has been found, for instance that *jamberi* (rough lemon) is the most vigorous rootstock both for sweet orange and acid lime scion varieties. *Gajanimma*, although it produces equally vigorous sweet orange trees in the pre-bearing orchard stage, has to be discounted because of its apparently extreme susceptibility to gummosis. For sweet oranges, *kichili* and limes form the second most vigorous group of rootstocks, with *billikichili* (a mandarin), grapefruit, sour orange and *santra* coming next in importance, and sweet orange and pomelo rootstocks and unworked sweet orange seedlings producing the smallest sized plants. Lime rootstock has shown itself to produce the smallest sized lime scion trees.

From a separate trial, it has been ascertained that the differences in sweet orange tree vigour observed between different grades of *kichili* and *jamberi* rootstocks prior to planting, tend to level out within 18 months of planting. It is therefore inferred that a rigid selection of seedlings in citrus seed and



A simple orange grading machine at work (designed at Madras)

Crop in the foreground Adt 1 and Adt 10 affected by blast disease.
Crops in the rear 11348 strain resistant to blast disease



Reclamation of alkaline soils

nursery beds for producing vigorous scion trees is a futile practice.

Root studies on a large number of unworked seedlings and budded sweet orange plants have revealed that some changes in grove cultural practices are desirable. Contrary to the popular belief, the citrus roots are found to forage far beyond the drip of leaves and, therefore, application of water and manures within the area covered by the tree top is clearly inadequate. These root studies have also been helpful in indicating the optimum spacing for orange trees on different root-stocks.

With the Nakamura method of side-grafting, it has been found possible to raise successfully some mango grafts with scion wood obtained from long distances and inserted three to five days after separation from parent trees—an achievement known to be impossible by the prevalent method of inarching.

A cheap machine for grading Kodur *chinee* oranges costing about Rs. 60 has been devised at Kodur with the aid of a grant from the Marketing Section, and this has been found to grade 3,500 to 4,750 fruits per hour into four grades (Plate 9). One of these machines has been purchased by the Kodur Fruit Growers' Cooperative Society and is now in use at their sale depot at Madras.

Work on fruit-canning and some fruit products has been in progress for some years now. Among the good quality products so far prepared are canned pineapple slices, candied citron peel, candied kumquats, citrus cordials, squashes and carbonated beverages, dehydrated powder and a breakfast food similar to 'grape nuts' from the wild fig (*Ficus glomerata*). The last product was prepared by the Government Agricultural Chemist at Coimbatore using the dehydrated fig powder prepared at Kodur. In a recent trial by some growers, who intend to start a large lime beverage factory at Madras on the lines advocated by the Fruit Research Station, Kodur, it was found that lime squash and cordials can be manufactured at less than 2 as. 9 pies per 12 oz. bottle (including the containers) a price which compares most favourably with the retail sale price of Re. 1-8 to Re. 1-12 per 24 oz. bottle of similar product in Madras.

RECLAMATION OF ALKALINE SOILS

IN parts of Trichinopoly district in Madras, paddy lands were found to be extremely saline as a result of prolonged water-logging. The *p*H of the soil was 10·5 and nothing would grow on it. A series of experiments conducted by the Government Agricultural Chemist showed the application of gypsum at 10 tons per acre and draining the land had a remarkable effect in reclaiming the soil. Two and a half years after the application of gypsum, a paddy crop giving a yield of 3,000 lb. of grain per acre was raised. The soil composition improved and the *p*H dropped to 8·5. The cost of treatment was Rs. 100 per acre.

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BLAST-RESISTANT RICE

THE blast disease of rice (*Piricularia oryzæ*) is a serious problem in several rice-growing tracts of Madras. The Mycologist and the Paddy Specialist are engaged in the study of the disease and the evolution of practical methods of control. Of the thousand odd varieties of rice in the Paddy Specialist's stock collections, some have been found to be highly resistant to blast. The Mycologist has evolved a field technique which enables him to estimate the relative resistance of several varieties in any one year. Taking advantage of this, new strains and selections are tried out every year. An outstanding achievement made by the Paddy Specialist is the evolution of some hybrid strains of rice which combine in them the disease-resistance of one of the parents with some of the desirable grain and yield characters of the susceptible parent. Strains 10998, 11340, 11348 and 5170 are examples of such progenies of a cross between G. E. B. 24 (resistant) and Adt 10 (susceptible) which are now becoming popular in the blast-affected tracts.

Another achievement of the paddy-breeding station, Coimbatore, is the isolation of economic mutants from the progeny of X-rayed seeds of the famous variety of rice G. E. B. 24. Some mutants so obtained have proved superior to the mother strain in that the tillering capacity of the plant has improved and the straw is better relished by cattle.

What would you like to know?

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section will be reserved for replies to selected letters in cases where it seems that the information might be of general interest.

Q: We are undertaking research into oil-seeds crushing problems and would like to have a list of the latest publications on oil-seeds and on the use of oil-cakes as manures.

A: Here is a list of a few references on oil-seeds, and the use of oil-cakes as manures.

Oil-seeds

Dunstan, W. R.—Oil-seeds and feeding cakes. (Murray, London, 1915).

Studies in Indian oil-seeds:

- No. 1—Safflower and mustard. By Albert Howard and others. (*Pusa Memoirs, Botanical Series*, Vol. 7, No. 7.)
- No. 2—Linseed. By G. L. C. Howard and A. R. Khan. (*Pusa Memoirs, Botanical Series*, Vol. 12, No. 4.)
- No. 3—*Carthamus tinctorius* Linn. The types of safflower. (*Pusa Memoirs, Botanical Series*, Vol. 18, No. 3, 1929.)
- No. 4—Types of *Sesamum indicum*. By D. C. Kashi Ram. (*Pusa Memoirs, Botanical Series*, Vol. 18, No. 5, 1930.)

Leather, J. W.—Composition of the oil-seeds of India. (*Pusa Memoirs, Chemical Series*, Vol. 1, No. 2.)

Tamhane, V. A.—Chemical studies on safflower seed and its germination. (*Pusa Memoirs, Chemical Series*, Vol. 6, No. 7.)

Howard and Remington—Safflower oil. (*Pusa Bulletin 124*,)

Imperial Institute, London—Trade Enquiry Reports—Report on oil-seeds. London, 1920.

Duke, J. A. H.—Oil-seed crushing industry of the U. P. (Government Press, Allahabad. 1931).

Lander—Indian vegetable oil industry. Lahore. 1927.

Yuill—Vegetable oil industry of Hyderabad state. (Government Printer, Hyderabad. 1930).

Oil-cakes. C. P. Department of Agriculture, Bulletin No. 8.

Winton—Structure and composition of foods, Vol. I: Cereals, oil-seeds, malts, etc. (Chapman and Hall).

Athawala, D. Y. and others—Studies of Indian mustard and rape-seeds and their oils, 1938. (Government of India, Industrial Research Bureau, Bulletin No. 13).

Krishna, S. and others—Minor forest products of Chakrata, Dehra Dun, Saharanpur, etc. Part I—*Oil-bearing seeds* (*Indian Forest Records (New Series) Chemistry*, Vol. 1. No. 1, 1936.)

Pundit, Y. G.—Report on the oil-pressing industry of Bombay. (Government Central Press, Bombay, 1914).

Sarin, J. L.—Vegetable oil-seed industry in the Punjab (Punjab Industrial Pamphlets, No. 4. 1933).

Duke, J. A. H.—Note on economic importance to India of castor-seed crushing. (U. P. Millowners Association, Cawnpore, 1937).

Das, B.—Crushing of Indian cotton-seeds and the commercial utilization of the products obtained. (*Journal of the Bengal National Chamber of Commerce*, Vol. 6, No. 1, 1931.)

Lewkowitsch and Warburton—Chemical technology and analysis of oils and fats and waxes. (3 Vols., Macmillan, London, 1921).

Brodie, N.—Indian vegetable oils (Industrial Research Bureau, Bulletin No. 10, 1937).

Menon, A. K. and O. S.—Simple methods of refining oils. (Madras Department of Agriculture, Bulletin 36, 1934).

Bahl, J. C.—The oil-seed trade of India. (The New Book Company, Bombay, 1938).

Oil-cakes as fertilizer.

Pal, G. E. and Rakshit, S. C.—Decomposition of oil-cakes and formation of nitrate (*Proc. Nat. Inst. Sci., India.* Vol. 3, 1937, pp. 213-17).

Sahasrabuddhe, D. L. and Gokhale, D. H.—Effect of oil-cakes on some physical properties of soils. (*Poona Agrl. Coll. Mag.*, Vol. 25, 1933, pp. 10-16).

Itano, A. and Arakawa, S.—Microbiological investigations of organic manures. 1. Decomposition of rape-cake. (*Berichte des Ohara Institute.* Vol. 5, 1933, pp. 422-46.)

Yoshimura, K. and others—Different fertilizer values of rape seed oil-cakes produced in Japan and China. (*J. Sci. Soil, Japan,* Vol. 6, 1932, pp. 283-300).

Castor-cake—A manure for the cotton crop in Khandesh. (Bombay Leaflet No. 2 of 1924).

Plymen, F. J.—Oil-cakes—their uses as cattle food and manure. C. P. Department of Agriculture Bulletin 6, 1928. (New series.)

Castor-seed: its production and utilization (*Bulletin Imp. Inst., London,* Vol. 28, 1930, pp. 30-46)—(Gives use of castor-seed cake as a fertilizer and its manurial value, pp. 43-44).

Kapok—A survey of its production within the Empire and notes on its cultivation and uses. (*Bulletin Imp. Inst., London,* Vol. 24, 1926, pp. 18-36)—(Gives use of kapok seed cake as a fertilizer and its manurial value, p. 24).

Utilization of lime seeds. (*Bulletin Imp. Inst., London,* Vol. 20, 1922, pp. 465-68)—(Gives manurial constituents of limeseed residue, which is stated to have high manurial value, p. 467).

Oil of the physic or purging nut (*Jatropha curcas*) (*Bulletin Imp. Inst., London,* Vol. 19, 1921, pp. 288-91)—(Gives constituents of the cake which has a high value as a manure, p. 291).

Industrial position of copra, coconut oil and coconut cake. (*Bulletin Imp. Inst., London,* Vol. 12, 1914, pp. 557-77).

Residual values of feeding stuffs and fertilizers. Revised tables (*Scotland Dept. Agri. Misc. Publn.* 7, 1937) H. M. S. O., Edinburgh. (Gives the composition and manurial values of cotton-cake, linseed-cake, soybean-cake, palmnut-cake, coconut-cake, earthnut-cake and rape-cake.)

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Q: I own several farms in the Punjab where I use bullocks for general work and camels for drawing water from wells. I find that bullocks and specially camels lose condition due to hard work. No one has been able to tell me exactly what is the economical amount of concentrate for good condition to be kept up.

I give one seer of cotton seed and half a seer of oil-cake to each bullock and two seers cotton seed with half a seer *khal* or oil-cake to each camel.

What is the best feed for my animals ?

A: When the animals are doing hard work the ration mentioned is far below their requirements. The following concentrate mixture when fed over and above the roughage is likely to give satisfactory results:

Cotton seed	65 parts
Maize	25 parts
Wheat bran	10 parts

The mixture should be fed approximately at the rate of 9 seers per 1,000 lb. (or 12·5 md.) body weight of animals when the animals are doing hard work, i.e. 8 hours a day. But when the work is of medium type, i.e. about 6 hours a day, 6 seers of the mixture per 1,000 lb. body weight may be considered sufficient.

There should be no limitation as regards roughage intake. It should be as much as the animal can eat at will.

F

INFORMATION PLEASE

Can any reader tell us where seed of the fodder plant *Kudzu Pueraria thunbergiana*) can be had in India ?

A Tanganyika reader writes :

Please give me a few suggestions to make a wooden all-round plough.

Readers are invited to answer this question. The best answer received by 15th February will be published together with the name and address of the sender.

was extremely heavy and continuous and caused some damage to crops. In the rice tract the monsoon started a little late and then came two months of continuous rainfall which was too much even for rice. This was followed by seven weeks of complete drought. This long drought created a very serious situation and the rice crop in the unprotected light soils was badly damaged. Fortunately rain came again towards the middle of October and eased the situation very considerably. It saved the rice crop in the heavier soils and definitely improved the prospects of the *utera* crop, i.e. catch crop taken after rice. The October rain, fairly widespread, was extremely favourable, particularly to *rabi* crops. It not only increased the moisture content of the soil but helped to produce a good tilth and ensure successful germination.

Many parts of this province are being invaded by a weed variously known as *kutwa. gokhru*, *gokhdu*, *ardhashis* or *ardhashishi*. Its botanical name is *Xanthium strumarium*. This weed has existed in this province for a very long time but in recent years it has been spreading at an alarming rate. It is generally found growing on uncultivated land, *bunds*, wastes, road-sides, banks of *nallahs*, poor pastures, etc. It has also been found growing in the rice fields, but it makes its appearance only when the land has dried up. It cannot thrive on good pastures for it is not a good competitor with grass; but it easily spreads on village waste land generally used by cattle for grazing.

It is a coarse annual herb with spotted stems bearing triangular and slightly hairy leaves. It grows to a height of about three to five feet. It comes into flower during September-October. The most prominent feature of the plant is its fruit of which there may be a hundred sometimes on one plant. They are held in peduncles on the top of the plant. Each fruit is about an inch long and is closely covered with hooked spines. It gets easily stuck on to the coat of the animals and is difficult to remove. It is a common sight to see hundreds of these fruits sticking to the body of cattle returning after grazing. Each fruit carries two seeds which may germinate in from one to ten years.

It is understood that this weed is also spreading rapidly in many other parts of India. A similar weed popularly known as Bathurst Burr (*Xanthium Spinosum*) has invaded the pasture lands of Australia and is causing considerable loss to the Australian wool trade. The Australian Government have sent out entomologists to search the world for a parasite which will exterminate this pest. It appears that the only practical way to eradicate the pest is some kind of biological control.

Expansion of sugar cultivation

The survey carried out by the Marketing Section of this department on the sugar position pointed out that this province was importing practically the whole of its sugar and nearly half of its *gur* requirements. A scheme for the development of cane cultivation under the Maniari and Kharung tanks in Chhattisgarh division has recently been started and the progress so far achieved appears very satisfactory. It is expected that in another two years there will be about 3,000 acres under these two tanks alone. Government have recently started a small open-pan sugar factory at Lormi which will deal with an area of about 150 acres working double shift, and it is hoped that a fairly large-scale factory will be started in the near furture by private enterprise. In the meantime efforts are being made to increase the area under cane in other parts also.

Consolidation of holdings

Perhaps the splendid work which this province is doing in consolidating the fragmented holdings in Chhattisgarh division has not received its full measure of publicity in the rest of India. Chhattisgarh is a very backward tract and the main crop is rice. Fragmentation of holdings is very serious and it is quite common to find an average holding which is about 12 acres split up into 30 or 40 fragments scattered all over the village. The evils of fragmentation were recognized long ago and some villages were consolidated as early as 1905 by voluntary effort. The work was put on a systematic basis by passing the C. P. Consolidation of Holdings Act in 1928. The Act provided for the transference of encumbrances and rights to the new holders

and provided for the appointment of Consolidation Officers. Since then the work has been progressing at a very rapid rate. Since the passing of the Act consolidation has been completed in 1,685 villages (September 1939) in which the *khasra* numbers have been reduced from 3,336,445 to 566,829 or by 83 per cent. The work is gaining ever-increasing popularity and the cultivators are now fully alive to its benefits. The cost per acre of the area consolidated varied from 4 as. 10 pies in Raipur and Drug to 5 as. 3 pies in Bilaspur.

A test for ghee

The Agricultural Chemist has been, for some time, trying to evolve a simple method of testing the purity of ghee, and is now well on the way to success. The method is as follows: the sample to be tested is melted and filtered. Two c.c. of the melted fat are taken in a test tube and an equal amount of moisture-free glacial acetic acid is added to it. The mixture, which is turbid, is gently heated until it is clear and is allowed to cool down. The temperature at which the turbidity begins to reappear is noted. It has been found that if the temperature is above 60° C. the sample may be considered suspicious.

MYSORE

By M. Vasudevamurthy, B.Ag.

Secretary, Mysore Agricultural and Experimental Union, Bangalore

THE glorious regime of Sri Krishnaraja Wodeyar IV, which has recently terminated, laid the foundations of many an innovation calculated to enhance the welfare of the farmers of Mysore. The inception and expansion of the Mysore Agricultural Department itself may be counted as one of the achievements of this period. Even for those who do not stop to analyse the science behind the results, who have an eye only for the spectacular, monuments of the rule are plenty. Who, that stops to wonder at the transformation of the dry Mandya tract into a fertile and prosperous region, ever fails to remember with gratitude and admiration the name of a Maharaja whose memory is perpetuated by the great reservoir, Krishnaraja Sagara, with a scheme of irrigation extending to 120,000 acres!

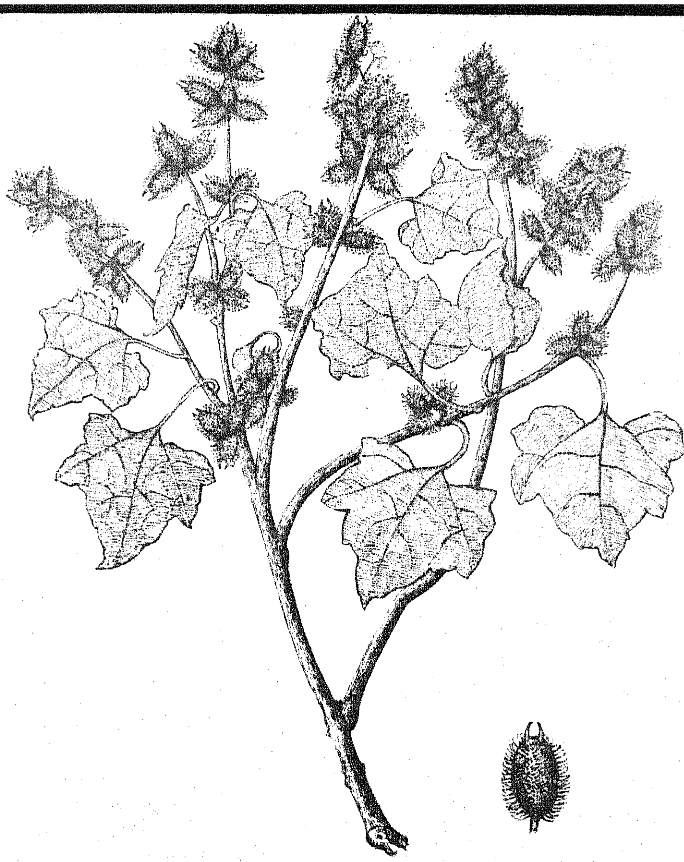
A tribute

As long ago as January 1924, even before such monumental developments had taken shape, Mr S. Milligan, then Agricultural Adviser to the Government of India, speaking at the opening meeting of the Board of Agriculture in India, held at Bangalore, said that it was a well-known fact that the prosperity of the state was 'due in no small measure to the incessant and unsparing efforts of its highly enlightened and sympathetic ruler'. The annual value of the improvements of the Mysore Agricultural Department, he estimated, amounted to many lakhs of rupees and thus the expenditure on the Department was returned by the soil many times over.

In the words of His Highness...

The meeting of the Board of Agriculture referred to was in fact opened by His Highness the Maharajah, in a speech which showed an appreciation of the fact that work for the development of agriculture, our basic industry, must have the most profound and far-reaching effects on the prosperity of the state. The speech was appreciated for its clear statements, and His Highness's opinion of an experimental farm can be quoted in full. His Highness observed:

'Experimental farms should, it seems to me, be looked upon primarily as outdoor laboratories where you seek for definite information as to the best methods of crop and livestock production for a particular area. Just as a large manufacturing concern maintains one or more laboratories with a scientific staff to investigate manufacturing and other problems which confront it, so the state main-



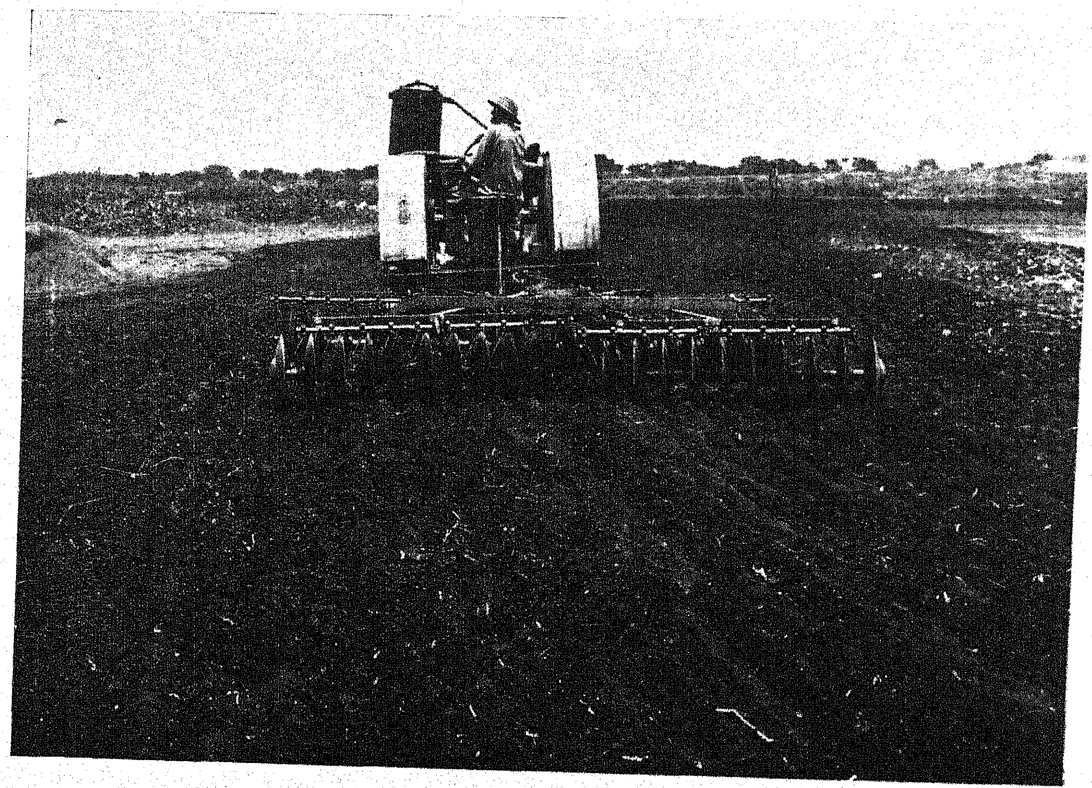
Xanthium strumarium Linn.

Local vernacular names

Ardhasis - Gokhru - Gokhdu - Konkon

A branch showing clusters of fruits

A Stretch of *Xanthium strumarium* which has invaded the Central Provinces. This waste land provided some grazing to cattle before it was overrun by the weed.



The tractor on the Irwin Canal colony in Mysore

Tobacco on the colony

tains these farm laboratories for the investigation of problems connected with its main industry, agriculture. It is safe to say that no manufacturing concern would expect its scientific laboratories to be self-supporting, although it is quite conceivable that some products from these laboratories would have a high money value. In the same way it appears to me extremely unwise and short-sighted to lay emphasis upon the money-making side of the experimental farm. At the same time, the greatest care should be exercised to see that funds are expended as economically as possible consistent with sound work. Certainly an Agricultural Department should be judged not by the money returns obtained from the farms under its control but by the influence it exerts upon the agriculture of the state. A criterion similar to this is the one by which any manufacturing concern would judge the usefulness of the laboratories it maintains.'

The Palace dairy

'The improvements of our livestock of which cattle form the principal item,' His Highness said in the same speech, 'is undoubtedly one of the most important questions affecting Indian agriculture today and it is one in which I personally take a special interest.' Apart from the cattle-breeding stations of the state Agricultural Department, there are two dairies in this part of the country which attract the attention of those interested in this problem. One is the dairy of the Imperial Dairy Institute, at the Civil and Military Station, Bangalore, and another is the Palace dairy farm at Rayanakere, near Mysore. The state Agricultural Department has studied many a livestock problem cooperating with the Palace dairy farm. Experiments on feeding cattle with groundnut-cake and growing sunflower for silage may be mentioned. Most recently some results from artificial insemination have been reported from this farm.

Agricultural colony on the Irwin Canal

The Agricultural Department has just established the first batch of colonists in the Irwin Canal area. Government was pleased to order that Rs. 1,000 be taken from each colonist as a deposit in token of his earnestness and as security for the amount advanced by the Government to the colonist on account of capital cost and working expenses; that the advances made to the colonists will carry no interest for the first 4 years and will bear interest at 4 per cent per annum thereafter; that the balance of advance after adjustment of the deposit will be recovered in five equal annual instalments from the fourth year, and that if the colonist chooses to purchase the land, the purchase price will include the balance of advance that may be due by him.

Under these terms the colonists are leaseholders for the first six years. The committee appointed in connection with the colony have estimated that under the triennial rotation of crops and with the growing of money crops in the colony the income for each colonist will be about Rs. 600 per annum. The colonists have already made good progress with planting tobacco as their first money crop. The public will watch this experiment for the proof that a number of educated people can take to agriculture cooperatively and really benefit by it.

Veterinary conference

The holding of the Conference of the Mysore Veterinary Association this year coincided with the reorganization in the Agricultural Department combining the Civil Veterinary, Livestock and Amritmahal sections. The Director of Agriculture referred to this in his speech at the opening of the Conference and it was indicative of how, even in these days of specialization, a certain amount of co-ordination of subjects would lead to practical results. The appeal to the veterinarians to devote themselves as much to the creative side of their subject as they are now doing to the pathological side of it, brings to mind the words of His late Highness, spoken with reference to a sister profession, the medical: 'I appeal to you all not only to support the hospitals that provide for the sick and the suffering, but at the same time to do all you can to reduce the need for hospitals by building up a better standard of health in the generation to come.'

Improve the fodder supply

One of the most important problems to be solved with reference to livestock is to improve the fodder reserves. This is a many-sided problem involving the knowledge of the various feeding stuffs available, better utilization of pasture lands and proper conservation of fodder. The improvement of pasture in Mysore has been much discussed within the last few decades and interest in it has again been revived.

When raising the status of the *gomals* to that of grassland farming, new experiments might be tried, suggested the Director, and if successful, these would certainly serve the cattle of the Mysore State with better nutrition. The introduction of dry land Napier grass is one step and as a step further, a leguminous crop like horsegram can be sown between the rows of the grass to be cut along with it. The Director of Agriculture was of the opinion that even grass and lucerne could be grown together without detriment to one another.

New ideas infuse new life into old organizations, and the Veterinary Conference was both a pleasant and an invigorating function.

SIND

By T. J. Mirchandani, M.Sc., Ph.D. (Lond.)

Agricultural Research Station, Sakrand

THE first Sind Livestock Conference was held on 26 and 27 July 1940 under the chairmanship of the Hon'ble Minister of Agriculture, Rao Sahib Gokaldas Rochlani. In declaring the Conference open, the Chairman said that the object of the gathering was to take counsel upon what may best be done in order to promote early improvement of the livestock industry in the province. The immediate problems of the province are :

(1) To take steps to improve the condition of work cattle by scientific breeding and feeding.

(2) To improve milch cattle, produce more milk and increase the consumption of milk and its products in view of the fact that both the milk yield and *per capita* consumption in the province is low.

(3) To promote industries connected with animal products such as dairy, poultry, wool, hides and skins, on well organized lines.

Livestock Conference recommendations

After detailed. discussions on the agenda, the Conference made several recommendations, the more important of which was that a Provincial Livestock Board, with His Excellency the Governor of Sind as the Patron and the Hon'ble Minister of Agriculture as Chairman, should be set up to establish and administer a permanent livestock improvement fund and to advise the Government on all matters relating to livestock improvement in the province. The Conference requested the Government to provide initial funds and to allocate a portion of grazing fees and *punchari* collected by the Forest and Revenue Departments.

The other important decisions of the Conference were to recommend the establishment of a livestock research station for the province, the formation of a breed society for the Red Sindhi breed, the organization of the *gowallas* in the vicinity of Karachi so that the milk is produced under hygienic conditions, the improvement of marketing facilities of all dairy products and the reduction in the rates of assessment on fodder crops.

The Conference was of opinion that facilities for grazing should be extended to Karachi taluka and Kohistan area ; the grazing of the cattle should be limited to the carrying capacity of each area, preference being given to herds with approved stud bulls. The cattle should be immunized against rinderpest before being admitted to those areas.

Improvement of three breeds

With the appointment of a Livestock Officer

for Sind, this section's work has received great impetus. Grading up of inferior stock by distribution of pedigree bulls forms the chief plank in livestock improvement in the province. The scheme for the establishment of separate cattle farms for Red Sindhi, Bhagnari and Tharparkar breeds has been partially carried out. The Willingdon Cattle Farm, Malir (which was closed as a measure of retrenchment), was reopened and a nucleus herd of Red Sindhi cattle is being maintained there. The scientific work is directed towards combining the characteristics of early maturity, high milk performance, vigorous constitution and high fertility in the future Red Sindhi type of animal. A pedigree herd of Bhagnari has also been established ; the female stock is stationed at the Government Auxiliary Farm, Shahdadkote, while the bulls are being reared at the Agricultural Research Station, Dokri. A nucleus of pedigree Tharparkar breed is stationed at the Agricultural Research Station, Sakrand. This breed is the most useful one to the cultivator as it is a dual-purpose animal for milk as well as draught.

Animal diseases

Considerable progress has been made in the problems of animal diseases by the Sind Veterinary Department, particularly by the Veterinary Investigation Officer under a scheme financed from the funds of the Imperial Council of Agricultural Research. For the first time in this province, experimental preventive vaccination, with formalized vaccine made in the field from the diseased lung tissue, has been carried out in actual outbreaks of contagious pleuro-pneumonia in goats. The results have been satisfactory. It has also been ascertained that abortion in goats is due to avitaminosis A, on account of scarcity of green fodder.

Investigation is in progress on several diseases of cattle and successful control is effected in many cases. The most common diseases in Sind are rinderpest in cattle, foot-and-mouth disease and parasitic diseases of cattle, sheep and goats. Liver fluke disease is very prevalent, especially in the Barrage areas, and thousands of animals are affected. This disease used to be successfully treated with carbon tetrachloride, but due to the war, it is very difficult to obtain this drug now. A substitute for this drug has not yet been discovered.

Rural reconstruction

The Department is under the administrative control of the Rural Reconstruction Officer and its activities are directed towards (1) improvement of the water supply, (2) sanitation and hygiene, and (3) agriculture and cottage industries. In addition to general work all over the province, a small area is selected in each district for intensive reconstruction. A District Sudhar Committee has been set up in each district, and the Rural Reconstruction Officer is advised and assisted by this Committee. Considerable headway has been made in the increasing number of tube-wells in the villages ; the levelling of village streets and removal of rubbish to outside the village ; jungle clearance and making new roads between important villages are now being attended to by the villagers themselves, and they also have begun to provide more windows in their houses. Laying out of orchards and small parks in select villages and poultry-keeping are being encouraged. The villagers are taking to these improvements and are greatly helping themselves with only some assistance from the rural reconstruction grants.

In select areas in each district, there is a district organizer whose duty is to explain to the villagers what is required to be done and to keep up their enthusiasm for the work. There is also a *kamgar* in most of these areas to do agricultural propaganda and to popularize the use of improved implements, better farming methods and the use of pure seed. There is a village reader who is supplied with local newspapers from district headquarters, and he reads these newspapers to the villagers. Model houses were built last year as a pattern for the villagers to copy. Over 60 houses were built by the villagers themselves on this pattern. This is highly encouraging. The next step is to build model villages. Plans are under consideration for one model village per district. The literacy campaign, organized by Government, gave stimulus to rural education and several new schools were

opened and village libraries established. Agricultural and industrial bias classes have also been established in some schools. In Hyderabad, Dadu and Tharparkar districts, an experiment has been started to provide circulating libraries for groups of villages. Organization of Boy Scout and Girl Guide groups for each village is the aim for which the Rural Reconstruction Department is working. Several groups, already started, have shown great spirit of service as instanced by the scouts of Larkana district who themselves took part in cleaning villages and removing refuse. Wherever possible, playgrounds are arranged for villagers and inter-village tournaments organized. Junior Red Cross societies have been active and more *dais* have been provided by the local boards.

The Rural Reconstruction Department thus coordinates the village work of many departments and assists in encouraging self-help amongst villagers. The response has been very satisfactory.

Long-staple cotton in Sind

Although attempts to cultivate exotic cottons such as American and Egyptian varieties in Sind date as far back as 1846, they did not meet with any degree of success. The cause of the failure was investigated by the Indian Central Cotton Committee in 1919 and they came to the conclusion that the fundamental cause was the unsatisfactory character of irrigation. They further held the view that provided perennial supply of water can be assured, Sind offered the most hopeful prospects for the successful cultivation of long-staple cottons. With the inauguration of perennial irrigation in Sind under the Lloyd Barrage and Canal System, this obstacle to the successful cultivation of quality cottons in Sind has been removed. The Indian Central Cotton Committee have now financed a scheme for a period of five years at the total estimated cost of Rs. 2,00,000.

The object of the scheme is to produce, by breeding, a hardy long-staple cotton, with a staple above $1\frac{1}{16}$ inch, spinning about 60 counts and yielding not less than 6 md. of seed cotton per acre. The main research station is located at Mirpurkhas in Tharparkar district and the sub-station at Oderolal in Hyderabad district. The work has only been started with the appointment of the Cotton Botanist and is expected to be of great economic value to the cotton industry in India.

Sugar beet

The Department of Agriculture in Sind is always on the look out for new crops that will supplement wheat in the *rabi* season, in order to raise the intensity of cropping to 54 per cent under the Barrage Canal system. Sugar beet was studied with this object in view and encouraging results have been obtained. The following details will be of interest to those who wish to grow this crop in India.

Deep rich soil with adequate drainage should be selected and manured 20 cartloads of compost per acre. The area is ridged and seed dibbled at 9 in. spacing on ridges. The seed rate is 6 lb. per acre. The seed was obtained from England. The crop needs 13 to 14 irrigations, each of two acre-inches. During the first fortnight, frequent watering (interval 4 to 5 days) is required to hasten germination, but later on irrigations at intervals of a fortnight to twenty days are quite adequate. The crop is best sown from the end of September to the end of October and matures from the middle of March to the end of April. It cannot be left in the ground after the end of April, as, due to high temperatures, the roots rot. Several varieties from U. S. A., Germany and England were tested, and the yield of roots varied from 200 to 250 md. per acre and the sucrose content ranged from 13 to 16 per cent. Amongst the varieties tested, Gartons' 426, Kuhn P and Schreiber S. S. were found promising, both from the yield and the sucrose points of view. The cost of cultivation was Rs. 56 per acre. The crop was unaffected by frost and was free from insect pests and diseases.

There is no doubt that this crop can be successfully grown during the *rabi* season under irrigated conditions in Sind, but its extension must necessarily depend upon the establishment of a beet sugar factory. This requires large capital.

The Month's Clip

COLOUR AND PLANT GROWTH

MANY old country gardeners have used and still use soot in quantity on their garden soils. Even though one may point out that soot contains little or no fertilizing value, nevertheless these gardeners regard the results obtained as satisfactory, states E. M. Straight, Superintendent, Dominion Experimental Station, Saanichton. Chinese growers insist on a black fertilizer. Fertilizer manufacturers have ceased to argue the point and incorporate in the mix a few pounds of lampblack. All are then satisfied. In 1939, in the Nanaimo district, a certain field received the wash from an old dump of coal dust and slag. The field of tomatoes showed outstanding growth in the blackened soil, with distinct falling off beyond on the red soil. Chemical analysis shows little fertilizing value in coal dust.

Work conducted at the Experimental Station, Saanichton, B. C., in 1939 would indicate that the growth of cantaloupes may be influenced by the colour of the mulch paper used. It was found that when the mulch paper was painted black, the soil temperatures were increased to a maximum of 10·5°F. over ordinary mulch conditions. Normally, under Vancouver Island conditions, the mulch paper becomes bleached by the end of June, presenting a greyish-brown appearance. Temperature records indicate that when this point is reached, the heat rays are apparently reflected rather than absorbed, with a consequent lowering of soil temperatures. In fact, they become lower than those on the unmulched soil. However, when bleaching is guarded against by blackening the paper, the temperature curve for the blackened area is significantly higher than it is for the unmulched soil area.

Extra vigour of plant growth is readily apparent between cantaloupes growing on the black and the unblackened mulch paper. Actual green weight of tops taken from the plants on the blackened mulch showed a mean increase of 61 per cent over those on the bleached mulch paper. What was more important, the blackened mulch gave an increase of 33 per cent in total yield of melons.

Previous tests at Saanichton with cantaloupes grown on mulch paper disclosed the fact that apparently the black paper retained its colour sufficiently long to impart the extra heat units required to give the necessary impetus to melon plants in June, the critical month for this crop.

Just how important a part colour plays in the attraction, absorption and the ramification of the infra-red and the other heat rays in the soil is not known, but future tests may indicate that the well known insistence of Chinese gardeners for black fertilizers may well be based on scientific fact. In any case, the yield of melons was increased 33 per cent by painting the paper black and keeping it so throughout the season at the Experimental Station.—*Press Note, Dominion Department of Agriculture, Canada.*

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VACREATOR PROCESS FOR CREAM

THE Vacreator process for the pasteurization and deodorizing of cream intended for buttermaking was designed by Murray Deodorisers Ltd., Auckland, New Zealand. This plant has been tried out thoroughly in all our Colonies with marked success. Most of the modern creameries in New Zealand and Australia, some in South Africa and Canada and at least one butter factory in India are equipped with this plant.

The objects of the process are (*a*) to reduce the bacteria and mould contents of cream to as low a number as possible, and (*b*) to deodorize the cream thoroughly from volatile flavours and odours such as food (grass, clover, etc.) taints and some accidental off-flavours. Two designs of plant are manufactured—the Solo and Tandem types. The latter carries the process of purification further than the

Solo unit, effecting additional concentration and cooling of the cream, and a sweeter product is produced.

The cycle of processes undergone by the cream are: (*a*) The neutralized cream is drawn into the pasteurizer containing live steam at 190°-200°F. under 6·5 to 11 in. of vacuum and pasteurized in the form of small drops falling from a spray pan. The cream boils at this vacuum-temperature combination. (*b*) The cream enters another vessel in which a vacuum of 15 to 20 in. and a temperature of 160°-180°F. are maintained. Here the cream boils vigorously and most of the foreign volatile constituents are evaporated. (*c*) The cream then enters a vessel maintained at 28 to 28·5 in. of vacuum and a temperature of 92° to 101°F. at which temperature the cream leaves the plant. The degree of vacuum controls the temperature of the cream at each stage automatically and the flow of the cream through the plant is also automatic.

The cream is then either ripened and cooled for flavoured butter or cooled at once and set for butter of low flavour.

The method is claimed to produce superior butter to the ordinary flash pasteurization method. The product from cream treated by the process has an improved flavour and a total absence of weed and food flavour. The method is claimed also to bring about a more efficient bacterial destruction and to produce a product of longer keeping quality. The process is specially suitable for processing cream from animals which are fed almost all the year with green grasses and clovers. The method is also useful in improving the quality of second-grade cream since the steam treatment has a small washing effect on the fat globules. The Vacreator treatment is suitable only for fresh or neutralized cream.—*Dairy News Letter.* [Abstract: W. L. D.]

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ALFALFA-BROMEGRASS AND MILK

EXPERIMENTS conducted at the Michigan State College of Agriculture and Applied Science in regard to the effect of alfalfa-bromegrass pasture on the flavour of milk have shown that when cows were milked three times daily and grazed on alfalfa-bromegrass pasture during the short periods between milking, their milk, whether drunk cold or at ordinary lukewarm temperatures after pasteurization, had a decided alkaline flavour which was very offensive and nauseating. Alfalfa, whether as a pasture or as a hay, produced a more pronounced effect on the flavour of milk than did the bromegrass.

When the 'three timer' cows were taken off the alfalfa-bromegrass pasture three hours before milking, a reduction in the intensity of the objectionable flavour was observed, and when cows were kept off the pasture seven hours prior to milking no such flavour was noted in the milk. Grazing on Sudan pasture after having pastured on alfalfa-bromegrass seemed to be ineffective in preventing the objectionable flavour in the milk, although cows kept on Sudan pasture alone yielded milk free of such odours.

Cows grazed on alfalfa-bromegrass pasture and milked twice daily yielded milk free of objectionable odours because on account of the longer periods between milking they were able to satisfy their nutrient requirements from the pasture outside of the five-hour contamination period prior to milking.—*Quarterly Bulletin, Agricultural Experiment Station, Michigan.* [Abstract: R. L. K.]

***

ORGANIC MATTER IN SOILS

ALTHOUGH by far the greatest fraction of an ordinary mineral soil is derived from the weathering of rocks, decomposed rock fragments alone do not constitute a soil, states H. J. Atkinson, Division of Chemistry, Dominion Experimental Farms Service. The presence of organic matter is necessary in order that this mineral matter may become a soil and grow crops successfully.

Most of the soil organic matter is derived from growing plants, but some of it also comes from decomposing animal remains. In the decomposition of these materials, complex chemical reactions take place which not only give simple compounds such as ammonia and carbon dioxide but also bring about the

accumulation of a complex material commonly known as humus.

Soils containing less than 3 per cent of organic matter are considered to be low in that constituent; those containing around 10 per cent are very well supplied. The so-called organic soils, mucks and peats, have very much higher quantities of organic matter, varying from 20 per cent to 80 per cent or more.

It has been observed generally that soils well supplied with organic matter are more fertile than those of low organic matter content. This constituent has a number of very important functions in the soil. One of these is as a storehouse for certain plant nutrients, particularly nitrogen. The decomposition of soil organic matter is brought about through the activities of millions of bacteria. These bacteria derive their energy from the humus, and in the process, break it down into simple substances, releasing nitrogen, sulphur, etc. in forms in which plants can use them as food. Any cultural practice which will encourage the growth of bacteria in the soil without at the same time causing extreme loss of nutrients, will result indirectly in improved plant growth because of the more rapid decomposition of the plant residues and humus which will take place.

Organic matter is commonly added to cultivated soil either in the form of manure, or by the ploughing under of a growing crop, a process which is known as green manuring. The latter practice not only returns to the soil the nutrients taken up by the growing crop but also enriches the soil with humus-forming material. If the crop being ploughed under is a legume, it is also possible that considerable nitrogen which has been obtained from the air by the legume is added to the available nitrogen supply of the soil. The application of barnyard manure also adds organic matter to the soil and considerable plant food, especially nitrogen, phosphorus and potash, and in addition, it increases the active bacterial population of the soil, the benefits of which have been pointed out above.

Organic matter in soils also improves their physical condition. On clay soils it has a loosening effect, giving better drainage and aeration. On sandy soils, it tends to bind the particles together due to its greater cohesive power than that of sand. It also increases the water-holding capacity of the soil, a factor that is important in districts of low rainfall. In general, it improves tilth and thus facilitates drainage, root extension and bacterial activity.

The effect of organic matter on the physical condition of the soil is so marked that it is claimed that the presence of 15 per cent to 20 per cent of organic matter almost completely removes the distinctions between sands, loams and clays.—*Press Note, Dominion Department of Agriculture, Canada.*

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THE ANNUAL CLEAN-UP

THE importance of the annual clean-up for all poultry yards and equipment is a matter worthy of greater attention than the average flock manager recognizes. The practical value of maintaining sanitary conditions on the commercial poultry plant as well as on the farm has been proven many times over. The high death-rate commonly encountered in laying stock could be greatly lowered if flock owners would practice even ordinary sanitary precautions the year round, states G. C. Hodgson, Poultry Division, Central Experimental Farm, Ottawa.

June is an excellent month to start a concentrated clean-up programme. Nesting material, litter, and overhead straw should be removed from the pens and burned. All movable house fixtures should be taken out, scraped, scrubbed and disinfected. Within the hen house the floor, walls, ceiling, dropping boards, and feed hoppers should be thoroughly cleaned. The floors should get special attention as many poultry diseases can be traced directly to filthy floor conditions. Once the litter is removed the whole floor area should be carefully cleaned right down to the concrete or bare boards and then thoroughly disinfected. Besides the hen house, the brooder house, feed house and colony houses demand equal care if healthy chicks and layers are to be reared in successive years.

In all cleaning operations, washing, scraping and the liberal use of disinfectant is strongly

advised. Where possible, water pressure applied by means of a hose is an excellent method of removing dirt not only from the walls and ceiling but also from the floor. Along with plenty of water, lye and coal tar disinfectants should play a prominent part in the annual clean-up. A 3 per cent solution of lye (1 lb. to 5 gallons of water) should be vigorously applied to walls and floor by means of a stiff brush, old broom or spray pump. Cracks and crevices demand careful cleaning. Positive penetration of disinfectants into these places of filth is good assurance of improved health in next season's stock. In using disinfectants it is well to bear in mind that they are more efficient when made up to proper strength for the purpose desired and also when applied to surfaces free of loose dirt. Of great importance during a general clean-up is the realization that nothing can substitute for thorough scraping with knife or other instrument and the washing of all parts of the house and of all utensils that come in contact with the hens during the year.

The land itself around the poultry buildings needs care. The runways that were used last year and are now idle should be ploughed, cultivated, levelled off, and seeded to clover or alfalfa. This is not only a good sanitary measure, but also provides excellent range for next year's stock. Rotation of runs keeps the land sweet and clean at all times.

The general raking up of old sticks, papers, and other trash which has accumulated during the past months makes a tremendous difference not only to the look but also to the cleanliness of any poultry yard.

Culling, at this time of year, should also be mentioned as many consider this operation a real clean-up of non-layers and birds in poor health. Cleaning out a flock of unproductive birds often eradicates many potential disease-carriers and in this manner alone the health of the whole flock is improved and the mortality of the coming winter correspondingly reduced.

The importance of the annual clean-up cannot be over-emphasized. The essentialness of this practice in good poultry management has shown itself worthy many times over in lowered flock mortality, improved health, livability, and increased egg production.—*Press Note, Dominion Department of Agriculture, Canada.*

New Books and Reviews

Banglaya Palli Unnayan

By KHAN SAHIB MOHAMMAD OSMAN GHANI (Published by the Secretary, Rural Uplift Council, Sirajganj. 6 as.)

KHAN Sahib Mohammad Osman Ghani deserves congratulations on his brochure, *Banglaya Palli Unnayan*, which is a timely publication. People have long been badly in need of such a guide. A glance at the pamphlet will not fail to convince the reader that the Khan Sahib's is eminently a practical scheme for the reconstruction of stagnant villages. Every line carries with it the conviction that translated into action in the spirit in which the Khan Sahib has written it, nothing will remain to be desired in village life in the course of a decade. Those who find the financial problem the stumbling block to all schemes of rural development and reconstruction will find a successful means of overcoming it in the *mosty-vikshya* system advocated on page 49 of the booklet. Nothing has been achieved without a scheme planned beforehand, and the booklet may claim to have laid down a plan for the revitalization of the withering countryside of Bengal. [P. C. C.]

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Crop Production in India

By C. P. DUTT and B. M. PUGH (Available from B. M. Pugh, Allahabad Agricultural Institute, Allahabad, 1940, pp. 356. Rs. 9)

THIS book consists of two parts: Part I—General Principles of Crop Production, Part II—Field Crops. The first part deals with such matters as the plant body and its work, soil and its importance to agriculture, the improvement of crops, soil management, fertilizers and weeds. The second part contains 15 chapters, one devoted to each important Indian crop, a chapter to minor legumes, a chapter to minor oil-seeds and a chapter to fodder crops. Each chapter throughout the book is followed by a short bibliography.

To deal with such a range of subjects within 356 pages is a very difficult task. It is inevitable that much of the information must be general and that the reader must go for details elsewhere. It is an open question whether authors *should* attempt to include so much in one volume. The elementary botany contained in the chapter on 'The Plant Body and its Work' and 'The Botanical Classification of Crops' contained in chapter IV might perhaps have been omitted and the space otherwise used. One is also inclined to doubt whether in such a book it is desirable to include the use of statistical methods in crop improvement, or if the reader will be much benefited either by the compressed statement of fundamental considerations or the very detailed discussion of an experimental lay-out and the calculations following it. Apart from these considerations, however, the book may be regarded as a useful general textbook and reference book. The information contained in it as shown both by the text and by the bibliography is well up-to-date.

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Principles of Animal Biology

By LANCELOT HOGBEN, F.R.S. Second edition (London: George Allen and Unwin Ltd., 1940, pp. 416, 7*s.* 6*d.*)

PROFESSOR Hogben's *Principles of Animal Biology* has a much wider scope than an average textbook of zoology, for the author has adopted throughout a rather unusual plan of discussing the general organization of animals on evolutionary principles with special emphasis on the functional aspect. For this reason, it can be usefully employed to supplement laboratory work, for which several excellent manuals are already available. One of the main features of the completely revised second edition is the amount of new tabular matter that has been introduced in various places to help students in memorizing essential facts in a methodical manner. The sets of questions at the end of each chapter

would also help in fixing in memory the essential facts. The work is illustrated with neat and simple diagrams which make it possible to understand the text more fully.

The book is divided into two parts, namely, 'The Vertebrate Body as a Going Concern' and 'How Animals Differ'. In the first part, the author deals with such subjects as living matter and reproduction; the machinery of response and coordination; sources of energy of the animal body; digestion, respiration and excretion; the transport of materials in the animal body; the development of a new organism and the machinery of inheritance. In the second part are dealt with the diversity of animal life; the principle of the unity of type; unity of type among invertebrates; the principle of succession and the present-day conception of evolutionary theory. The text is supplemented with four informative appendices and a very useful index.

The book is written in a lucid, simple style and is not only helpful for the upper forms of schools, universities and polytechnics, but also has an appeal for the general reader who may wish to gain a knowledge of the essential features of the animal kingdom. The author and the publishers deserve thanks for producing the work at a reasonably low price.

[S. L. H.]

Rag Bag

Information please

MANY minds go to the making of a magazine. We invite readers to send short notes for this page. We are on the look out for information—facts, observations, jottings secured in all sorts of ways—of interest to other readers. So far the response has been very poor. We repeat the invitation in the hope that at least now, when good resolutions are fresh, some readers may be reminded of a resolution made a year ago and dig out material from their scrapbooks for use in INDIAN FARMING.

We should also like to draw the reader's attention to page 36 where, under the heading INFORMATION PLEASE, will be found a question without an answer. Readers are invited to send in their own answers to the problem stated. The best answer received by 15 February will be published, together with the sender's name and address, in the March issue of INDIAN FARMING.

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Animal husbandry progress

THE position in regard to the cattle improvement drive initiated by His Excellency the Viceroy has been reviewed and it has been found that there has been an increase of 2,815 bulls kept for stud purposes since 1935-36, constituting an increase of 28 per cent. in British India. Provincial and state livestock departments have also been advised that they should take steps to prevent the indiscriminate location of bulls received in connection with His Excellency the Viceroy's gift bull scheme.

As a result of the recommendations made by the Wing in 1936 the Madras Government have under consideration a bill to provide for the improvement of livestock in the province, on the lines of the act already in force in Bombay. The training of stockmen has been taken up in various provinces and in order to distinguish them from properly qualified veterinary graduates, it may perhaps be necessary before long to look into the question of the registration of the latter, along lines somewhat similar to the registration of medical graduates.

In order to encourage milk recording and the formation of breed societies, a bulletin has been issued defining the breed characteristics of seven breeds of milch cattle, literature relating to the systematic recording of pedigrees has been collected, the question of opening Central Herd Books is under consideration and model rules for a breed society have been framed and circulated. The question of the salvage of dry city cows has received attention and it is proposed, subject to the cooperation of the Government and municipal authorities concerned, to study the problem on the spot in the three presidency towns and suggest a suitable course of action.

Provinces and states are taking action to inform one another promptly of outbreaks of contagious diseases of cattle and are trying, subject to such funds as may be available, to arrange for the ante- and post-mortem inspection of animals slaughtered in public slaughter houses and to mark suitably bales and hides emanating from them.—P. M. KHAREGAT, Vice-Chairman, Imperial Council of Agricultural Research, in an address at the Animal Husbandry Wing Meeting at Izatnagar.

***

Large-scale silage operations

THE following statement shows the amount of green grass and green fodder ensiled at the Government Cattle Farm, Hissar, Punjab, over the past 20 years:

	Maunds (82 lb.)		Tons (2,240 lb.)
1919-20 .	19,710	=	722
1920-21 .	9,267	=	339
1921-22 .	15,931	=	583
1922-23 .	37,090	=	1,358

	Maunds (82 lb.)		Tons (2,240 lb.)
1923-24 .	31,103	=	1,139
1924-25 .	28,103	=	1,029
1925-26 .	50,446	=	1,847
1926-27 .	41,428	=	1,517
1927-28 .	39,650	=	1,451
1928-29 .	36,426	=	1,333
1929-30 .	62,439	=	2,286
1930-31 .	1,35,716	=	4,968
1931-32 .	1,03,110	=	3,775
1932-33 .	84,591	=	3,097
1933-34 .	1,30,123	=	4,763
1934-35 .	53,951	=	1,975
1935-36 .	1,09,771	=	4,018
1936-37 .	75,419	=	2,761
1937-38 .	1,94,985	=	7,138
1938-39 .	6,824	=	250
TOTAL .	12,66,083 md.	=	46,349 tons
Average .	63,304 md.	=	2,317 tons per annum

This is believed to be a world's record, both for any individual or any institution.

MGIPC—M—III-1-120—3-1-41—1,800.

INDIAN FARMING

ISSUED BY
THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

Vol. II : No. 2
FEBRUARY 1941

Subscription : Rs. 6 per annum : 8 as. per copy

PUBLISHED BY MANAGER OF PUBLICATIONS, DELHI
PRINTED BY MANAGER, GOVERNMENT OF INDIA PRESS, CALCUTTA

ICAR—21.2.41
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Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Imperial Council of Agricultural Research, Imperial Secretariat, New Delhi.

The subscription is Rs. 6 per annum, 8 as. per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertisements should be made to the Manager of Publications, Civil Lines, Delhi.

Subscribers in Europe and America should apply to the High Commissioner for India, Public Department (Publication Branch), India House, Aldwych, London, W.C. 2.

INDIAN FARMING

ISSUED BY
THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

Vol. II FEBRUARY 1941 No. 2

THE ENEMY IN THE DESERT

As far back as human history goes, locusts have been one of the dreaded plagues of mankind. They were the more feared as their appearance and disappearance seemed to be entirely erratic. They would come from nowhere, devastate the country perhaps for one season, perhaps for several years, and then disappear as mysteriously as they had arrived. But science has removed that ignorance.

The entomologist used to be regarded as a figure of fun, a mild, spectacled old gentleman chasing butterflies with a net. The modern entomologist is a man who gets to grips with the most deadly and elusive enemies of the cultivator—the insect pests. One of the outstanding contributions of entomological science in the last few years has been our knowledge of the reasons why locusts swarm and of the steps to be taken to prevent their multiplying.

Elsewhere in this issue will be found a résumé of the presidential address by Rao Bahadur Y. Ramchandra Rao to the Entomological Section of the Indian Science Congress held at Benares in January of this year. The locust problem is the subject of this address and the author is well qualified to speak on the subject. The main points for the layman to remember are these:

(1) The locusts (in this case the North-West or Desert Locust) are always with us in a *solitary form*. They exist in the deserts as widely scattered individuals which do not ordinarily get the urge to get together and migrate in swarms.

(2) If, however, conditions (mainly rainfall) are favourable, there may be extensive egg-laying followed by the appearance of hoppers on a large scale. If the immediately succeeding generations which usually concentrate in restricted areas for food, happen to find conditions favourable for breeding, they lay eggs in such dense masses that large crowds of hoppers are produced. The locusts now enter the *swarming phase*. Their very density affects their psychology, their shape and their colour and we get the migration of enormous swarms with the consequent damage.

This month—February—is a critical month with regard to the present threatened invasion of locusts. Good rains in certain desert areas last year caused apparently the production of two generations one after the other so that a *swarming phase* occurred and the insects of this phase have spread throughout various parts of the Punjab, Sind, Baluchistan, the United Provinces and certain Indian states in north-west India. In this month, these may now try to lay eggs, and the important thing is—

(1) to locate where eggs are being laid, and

(2) to destroy the hoppers (small wingless forms of the locusts) which emerge from these eggs.

Any one desiring further information on this should obtain from the Secretary, Imperial Council of Agricultural Research, a pamphlet entitled *Methods of Locust Control recommended by the Imperial Council of Agricultural Research.*

Original Articles

THE GROWING OF PYRETHRUM IN INDIA

By W. Burns, C.I.E., D.Sc., I.A.S.
Agricultural Commissioner with the Government of India

JUDGING by the number of enquiries received by the Imperial Council of Agricultural Research, there is very considerable interest throughout India in the possibilities of growing pyrethrum. The importance of pyrethrum as an insecticide and particularly as a means for keeping down mosquitoes is well known. The original home of the pyrethrum plant (*Chrysanthemum cinerariaefolium*) is believed to be Dalmatia. Another species, *Chrysanthemum rosea*, was also at one time used. It is not so effective as the first-named species, and is now little cultivated.

For a long time the supply of pyrethrum was almost the monopoly of Japan, the plant being grown mainly in the northern portion called Hokkaido. In recent years, however, it has been tried elsewhere and has been grown with marked success in Kenya.

Introduction into India

It is reported that in 1934-36 the Director, Malarial Survey of India, obtained seeds from Messrs Sutton in England and planted them at Kasauli and Karnal without success. The Punjab Government obtained pyrethrum seeds from America in 1933 and planted them at Lyallpur and Murree. In Kashmir pyrethrum has been cultivated for some time near Baramulla at an elevation of 5,000 ft.

In January 1937, the Imperial Council of Agricultural Research resolved on further trials. A small quantity of seed was secured through the India Office from the Director, Plant Pathological Laboratory, Harpenden, England, and was distributed to provincial Governments and certain states for trial. A later supply of seed obtained from Dalmatia (Yugoslavia) in the early part of January 1940 was also distributed. The cooperation of certain private individuals was also given in these trials. Pyrethrum has so far not been a success at the following places:

- Dharwar and Poona in the Bombay Province,
- Saharanpur, Dehra Dun and Chaubattia in the United Provinces,
- Sakrand in Sind,
- Ballehonnur in the Mysore State, and
- Ranchi in Bihar.

The crop has been a success at Murree (6,000 ft.), Kulu (5,000 ft.) and Palampur (4,000 ft.) in the Punjab and in Kashmir. There are also promising results from certain parts of the Nilgiris and the North-West Frontier Province. Summarizing Indian experience so far, it may be stated with certainty that pyrethrum thrives best in a comparatively dry climate and a well-drained light soil. It is susceptible to damping off in the monsoon. The temperate outer Himalayas seem suitable for growing pyrethrum.

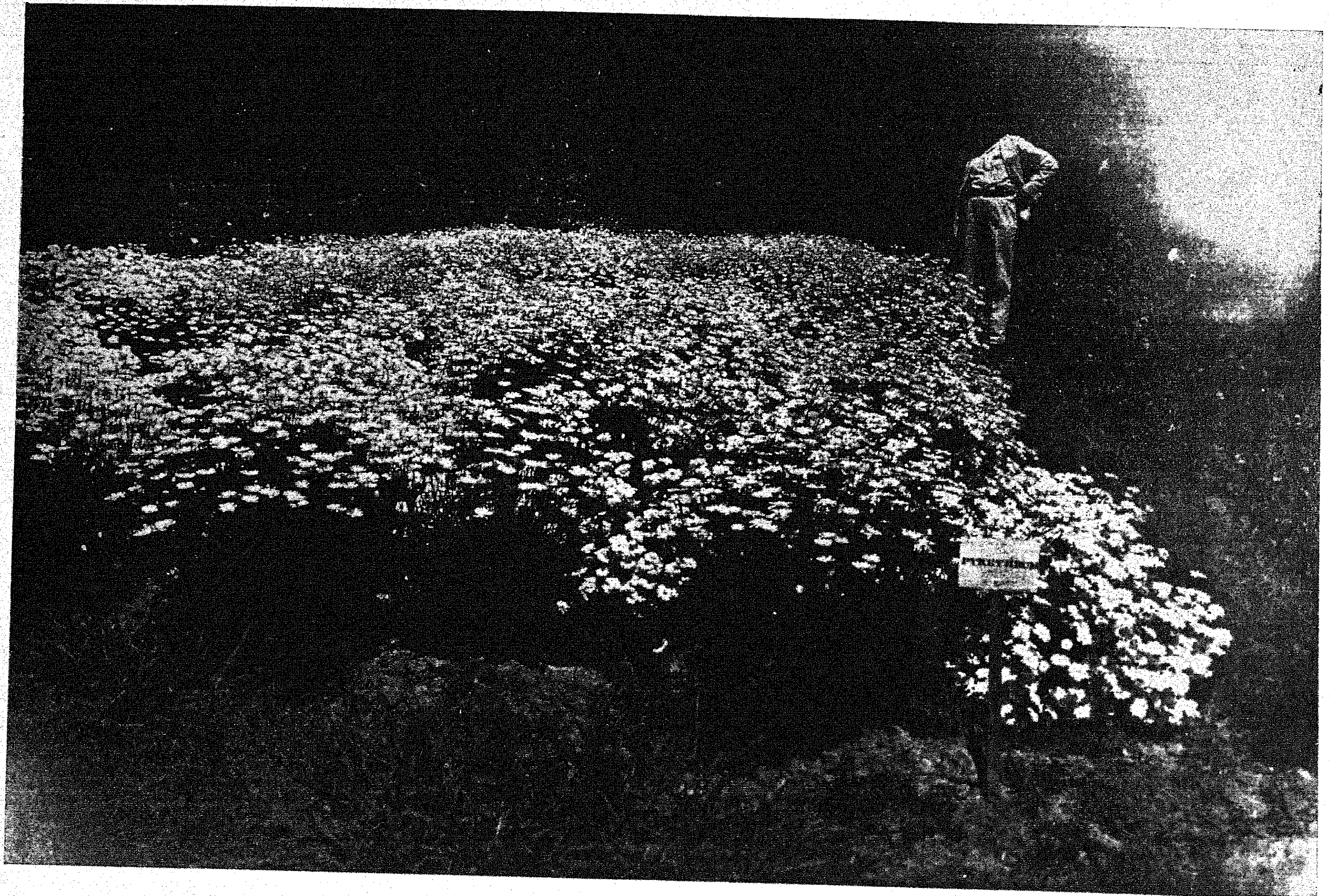
Punjab experiment

The Director of Agriculture, Punjab, informed the Imperial Council of Agricultural Research in March 1940 that it had been decided to rent one acre of land in the Kulu Valley and a similar area in Murree in order to grow pyrethrum with the object of collecting data as to the economics of its cultivation and on the basis of the information so collected to formulate a policy regarding future work. The method of cultivation followed in the Punjab is as follows:

The plant is grown from seed. Seedlings are first raised in a nursery and then transplanted in the field. The seed is sown in March-April. The seed begins to germinate in from 10 to 15 days. The seedlings when

Flowering clump of Pyrethrum from Hebbal (Mysore State)

[PLATE 15



Pyrethrum plot, Palampur (Punjab)

[PLATE 16

about three inches high are ready for transplanting into the permanent site. Pyrethrum can also be propagated from rooted suckers or splits of the parent plants. The suckers can be obtained from old plants which have become thick and bushy.

After the land has been prepared and manured, the seedlings are planted at a distance of 18 in. each way and irrigated immediately. The land has to be kept clear of weeds and irrigation given when necessary. After the setting in of the rains no irrigation is required, and the land has to be kept well drained. In the Punjab, pyrethrum flowers after about one year from the time of transplanting, flowering starts from the end of March and continues to the end of May. The flowers are plucked when they open, dried in the sun and marketed in this form. No definite figures of yield per acre are yet available from the Punjab. However, on the average, a yield of 400 lb. of dried flowers may be expected from one acre of good pyrethrum.

The method described above is, of course, adapted to Punjab conditions. In other places a different system may be required. As regards manuring it may be pointed out that Mr V. A. Beckly, Senior Agricultural Chemist, Department of Agriculture, Kenya, is of opinion that pyrethrum is intolerant of too rich soils. Manuring, therefore, may need to be done only if it does not affect the pyrethrum content.

Analysis of fully open flowers of pyrethrum collected from the Palampur experimental plot was made by the Agricultural Chemist, Agricultural College and Research Institute, Lyallpur. The samples showed a total pyrethrin content of 0·96 per cent.

Efficiency of Indian product

Samples of dry flowers from Palampur and Kulu were tested at the Malaria Institute of India, Delhi. In his letter addressed to Professor Jai Chand Luthra, the Director of the Institute reported as follows :

'Powdered dry flowers from Palampur and Kulu were separately soaked in kerosene oil in the proportion of 1 lb. of powder to 1 gallon of oil (100 gm. to 1 litre). The extract was decanted after 48 hours, the containers being vigorously shaken a few times during the interval. Tests show that the insecticides thus obtained are practically as efficient as the Pyrocide 20 mixture. In all the eight sets of experiments carried out the extract of flowers from Kulu seemed a trifle inferior to that of flowers from Palampur. 5·5 c.c. of the former extract are required per 1,000 c. ft. to obtain a 100 per cent kill as against 5 c.c. of the latter, 5 c.c. of Pyrocide 20 mixture being required per 1,000 c. ft. to give a 100 per cent kill of mosquitoes.'

In Kashmir, experiments on pyrethrum cultivation have been conducted by the Forest and Agricultural Departments and both have got excellent results. It is understood that the Kashmir Government contemplate its extension very considerably and steps have been taken to grow this plant as a protected crop. The samples of flowers produced from acclimatized seed have shown up well in both chemical and biological tests.

In Mysore there are now over 1,000 clumps of pyrethrum growing at Hebbal. These are about three years old and only 16 have so far flowered in spite of various manurial and other treatments intended to force flowering. Splits from flowering clumps were multiplied and these have just started flowering. Some of the seeds raised from the flowers produced at Hebbal were viable and these have been germinated and seedlings are being raised.

Best samples

Analyses made by the Director, Imperial Agricultural Research Institute, of pyrethrin buds and flowers from Parachinar, North-West Frontier Province, show a total pyrethrum content of 0·61 to 1·11 per cent. This is the best of the Indian samples so far analysed at the Institute but is still below the level of the Kenya samples which gave 1·36 per cent total pyrethrin. The Government Entomologist, Coimbatore, in a letter dated 14 February 1940, reported on the insecticidal effect of three samples of pyrethrum obtained from three different localities on the Nilgris, viz. Emerald Valley, Sim's Park and Kotagiri. These were powdered at Coimbatore and tried against caterpillars of *Prodenia litura*. The

material from Kotagiri was also used against caterpillars of *Plutella macullipennis*, a pest of cruciferous plants. The results of the trials are given below.

Name of places	1. Trial (30 November 1939) No of caterpillars tried	No. of caterpillars dead	Percentage of mortality	2. Trial (6 December 1939) No. of caterpillars tried	No. of caterpillars dead	Percentage of mortality
Emerald Valley . .	45	10	22	25	12	48
Sim's Park	32	8	25	25	5	20
Kotagiri	42	24	57	25	19	76
	100	100	100			

It can be seen from the statement that the material from Kotagiri has caused the highest mortality in the trials. It may be stated in this connection that the insecticide was used as soon as it was received, while the others had to be kept for two months for want of insects on which to conduct the trials.

There is now enough evidence to show that pyrethrum will grow in certain areas in India. What is needed is organized expansion of production and marketing with a chemical check on the pyrethrin content to ensure of the material being effective. The production of seed also needs attention.

SHEEP-BREEDING RESEARCH IN INDIA

By H. B. Shahi, M.Sc., M.R.C.V.S., D.T.V.M.

Director of Veterinary Services, Central Provinces and Berar

Of the various breeds of sheep the Merino is probably the most widely known all over the world. Few people, however, know that the Merino is stated to owe its origin to an Indian breed, the fat-tailed Dumba of northern India, and that the foundation stock of the now widely-developed sheep industry of Australia, yielding millions of pounds annually, is of Indian origin.

But while other countries have made rapid progress in sheep-breeding and the wool trade, India has stood still. What can be done by organization and hard work is illustrated by the success achieved in sheep-rearing in Peru. The indigenous sheep of this little country were even poorer than Indian sheep. The methods of wool utilization in practice were very nearly like our own. The sheep gave $1\frac{1}{4}$ to $1\frac{1}{2}$ lb. of wool per annum, and their chief use was for the export of *chalona* or dried meat. However, when the state took a hand in the improvement of the industry and enforced measures to improve conditions, the wool yield gradually increased to 3 lb. and then to 5 lb. per sheep, and the quality, according to an authority, improved to such an extent that today, when stabilized and produced in sufficient quantity, Peruvian wool bids fair to challenge comparison with Australian and Cape wool as sold at the London wool sales.

Dismal picture in India

While achievements such as these are being recorded in foreign countries, the Indian scene presents a rather dismal picture. In this country the industry is for the most part in the hands of nomadic tribes and poor shepherds who manage—few know how—to eke out a precarious existence from their calling. Their methods are primitive, and they wander from place to place in search of pastures for their flocks.

Let it not be supposed, however, that the sheep industry of India is negligible. According to the Livestock Census of 1935, there were over 25 million sheep in this country, of which 12 million were to be found in Madras, $4\frac{1}{2}$ million in the Punjab, 2 million in the United Provinces, $1\frac{1}{2}$ million each in Bombay and Baluchistan and over one million in Bihar.

In 1937-38 India exported the following sheep products:

		Quantity	Value Rs.
Sheep skin (tanned)*	. Tons	3,271	1,59,81,785
Do. (raw)	. ,,	800	13,71,680
Wool (raw) .	. lb.	37,989,319	2,64,55,835
Woollen products .		..	1,07,81,559

* These figures include Burma

In addition there is an extensive trade in lamb pelts which averaged 20 lakhs, worth $1\frac{1}{4}$ crores of rupees, in the past three years.

The average value of the annual imports of wool and woollen products for the past three years was 3·1 crores and of the exports 3·5 crores.

The Indian sheep industry, if systematically organized and developed, is capable of yielding far better returns. But before wool and other sheep products and their marketing can be improved, attention has to be given to the animal that is the source of these products. There have been in the past a few spasmodic and intermittent efforts to improve sheep-breeding, but no account is available of the progress made or why the efforts were abandoned. In recent years the Governments of the Punjab, the United Provinces and Mysore took some interest in sheep-breeding and imported Merino, Dorset Horn and Southdown rams with the object of crossing them with the indigenous sheep. These experiments showed that crossing improved the quality of wool and increased the yield from $1\frac{1}{2}$ to 7 lb. Nothing could, however, be done to stop the

tendency of the cross-breds of the second, third and fourth generation to lose size. Further, it was never definitely ascertained whether this tendency was due to a defect in the system of breeding or to methods of feeding, mating or some other unknown cause.

The Council takes a hand

Such was the position in 1933, when the Imperial Council of Agricultural Research took a hand in the matter. That year a sub-committee, which included non-officials conversant with the trade, was appointed to advise the Council on the lines of future improvement. The recommendations of the sub-committee are as follows :

'Systematic breeding work for the improvement of the following indigenous breeds should be taken up on a sufficient scale and for a sufficiently long period, not less than 10 years, to warrant reliable conclusions as to the comparative possibilities of the breeds dealt with, particularly for the development of the wool industry in India.

'The breeds considered sufficiently distinct and of sufficient all-India importance are as follows, viz. Bikaner, Deccani, Dumba, Guddi and Southern Madras red hairy sheep.

'Pure-bred flocks of not less than 100 ewes each of these breeds should be maintained in the most suitable breeding areas—as far as possible at existing farms—and systematically improved by selective breeding to ascertain the possibilities of improving these breeds, with proper care, particularly as to disease control and feeding and in order to provide rams for issue to suitable breeders. It was proposed that the different breeds should be dealt with at the following centres :

Bikaners—At Hissar and Hingoli.

Deccani sheep—At Hosur, Bhamburda (Bombay), at Mahbubnagar in Hyderabad State, and at a selected centre in Mysore.

Dumbas—At Bharkhand in Baluchistan.

Guddi sheep—At Kangra.

'The South Madras red sheep are only useful for mutton purposes and the committee did not propose to make any recommendations regarding them. The work already in progress at Hissar with cross-bred Bikaner-Merino sheep should be continued and extended and similar work with the Merino-Deccani cross should be carried out at Poona.

'At Hosur some experiments in cross-breeding Deccani sheep with Bikaners might be carried out but the main work at this farm should be the improvement of the local Deccani sheep by selective breeding and proper care.

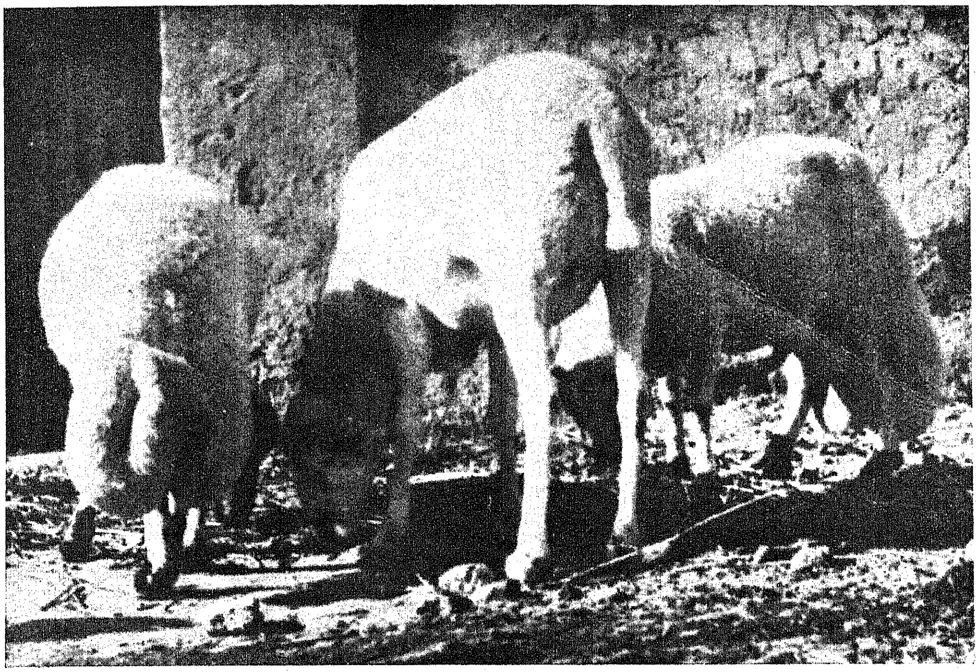
'The control of disease is a most important factor in sheep-breeding in India and definite provision should be made for the systematic investigation of sheep diseases at all farms to which grants are made.

'In such a coordinated scheme of work as is proposed it should be open to the Research Council to arrange for rams from any flock to be transferred to any of the other flocks financed by the Council as may be considered necessary from time to time.'

Since these recommendations were accepted by the Council, schemes submitted by provincial Governments and constituent states have been considered and funds allotted to them. Three sheep-breeding schemes in Madras, the Punjab and Bombay are now in operation.

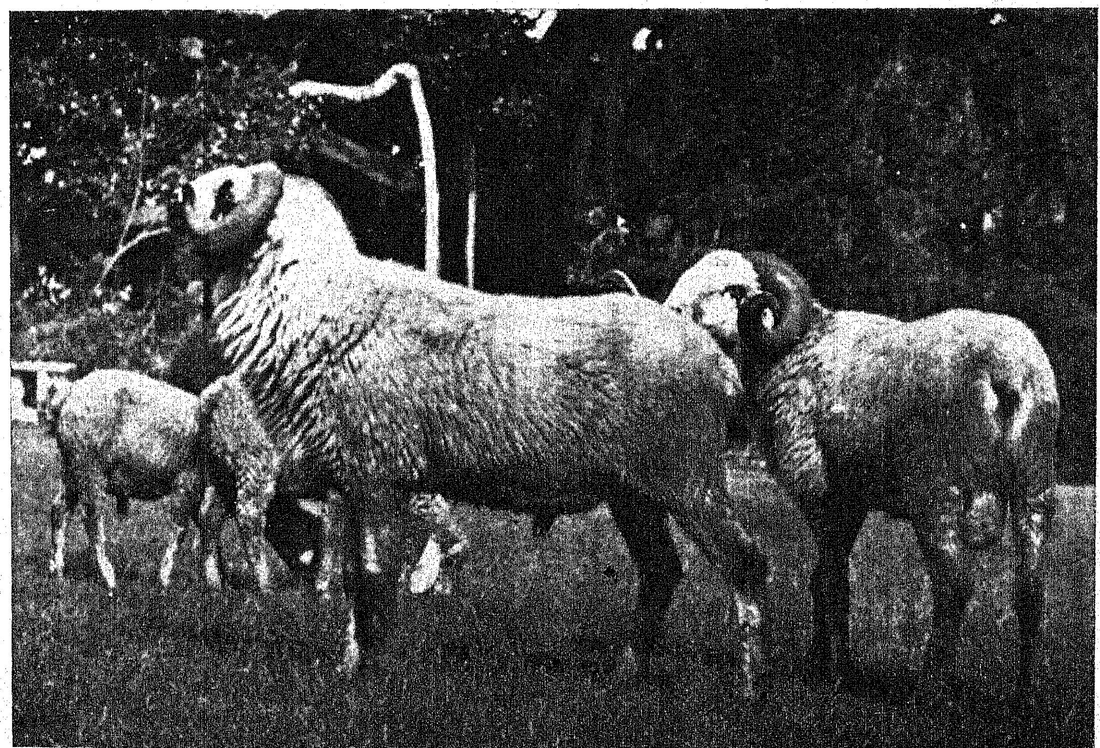
Madras

Madras has generally a hot climate, but in districts with a stimulating cold weather a woolly variety of sheep known as the Bellary breed is to be found. Most of the sheep are black and white, and the ewes are white with black markings on their faces and ears. When they are mated, the progeny consists of a fair number of black-faced lambs and a few white-faced lambs. The latter are delicate in constitution and cannot stand up to adverse conditions. By very careful attention some white-faced lambs have been reared, but they are small, weak and yield less wool. When these animals are mated together, most of the progeny is born dead or survives for a very little time after birth. The object of the breeding research is to raise a flock which will yield 4 to 5 lb. of wool per sheep. It is also proposed to use rams of the Bikaner breed for cross-breeding with the Bellary breed. It is hoped in this way to produce a sheep which will not only yield more and



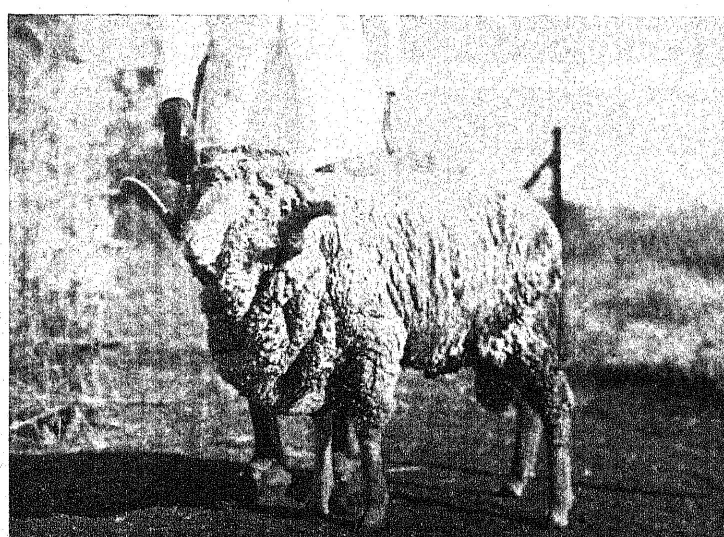
Delhi Dumbas

Below : Bellary ram



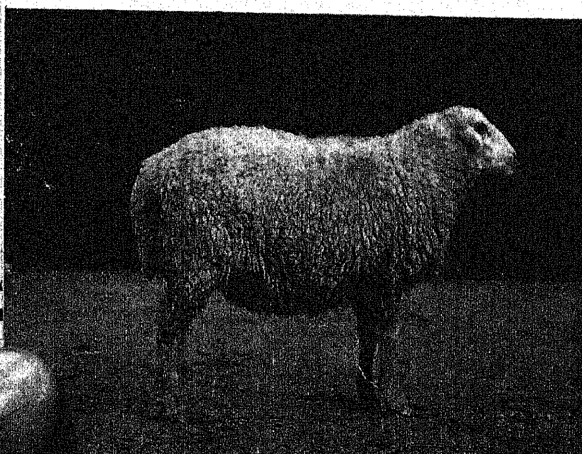
A typical Deccani ram

A typical Deccani ewe

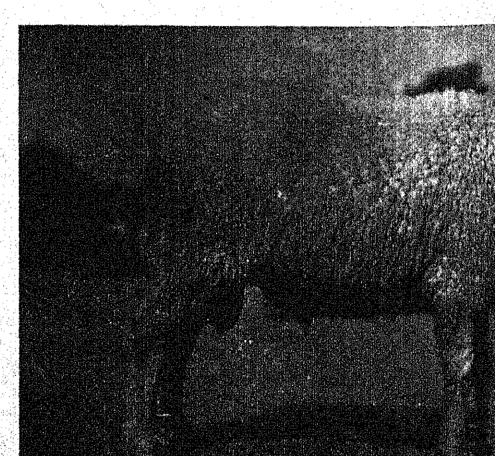


A Merino ram

A Bikaneri ~~ram~~ ewe



A Bikaneri ewe



better wool but also respond to feeding and fatten easily in the climate of southern India. It is also proposed to find out if two lambing periods in a year can be arranged without affecting the constitution of the ewes. The best time for castration will also be ascertained. Experience at the Hosur Cattle Farm has shown that by shearing twice a year—in February and August—it is possible to get a better annual wool clip.

The Punjab

The Bikaner breed, which is of considerable all-India importance, is reared extensively in the Punjab. Systematic improvement of this breed is in progress under a Council scheme at the Government Cattle Farm, Hissar. Here attention is given to the investigation of such economic factors as may be of value to sheep-breeders generally. The best methods and times of mating, docking, shearing and castration of sheep are being ascertained and pedigree sheep are being provided for sheep-breeders and for experimental work in other provinces. Not the least important part of the work are the demonstrations in the classing of wool, packing and marking.

The work started in 1936. An observation from a recent progress report is worthy of mention here. In foreign countries wool is washed as a matter of course as otherwise it does not fetch a good price in the market. In India, however, this is not generally done. Although washing improves the condition and general appearance of the fleece, the price offered in this country for both washed and unwashed wool is almost the same and the practice is therefore not profitable. This suggests that the marketing of wool is such a neglected business that there is no encouragement for the breeder to clean his sheep by washing. A study of the effects of washing on the growth of wool is also in progress and results will be available shortly.

For controlling the worms in the intestines of sheep which very seriously affect the health of these animals, the usual practice adopted at the farm is to dose the animals monthly with the following solution:

Copper sulphate . . .	4 ounces
Powdered mustard . .	4 ,,
Water up to . . .	3 gallons

The dose is two to four ounces according to the size and age of the animal.

Supplementary control measures aim at grazing of flocks in small groups and frequent change of pastures. The lambs are weaned at three months of age and are grazed separately.

Another parasite which commonly troubles the sheep is the nose fly, known as *Oestrus ovis*. Their maggots are located in the nasal cavity of the sheep and are responsible for loss in condition. The preventive measures adopted at the farm against this pest are:

(i) washing the noses of all the sheep with potassium permanganate lotion twice weekly, and
(ii) syringing mercury perchloride lotion in the nasal cavity once a month.

Where the infection is particularly heavy, the rubbing of some repulsive agent, such as carbolic oil, on the noses during the fly season, is practised.

Bombay

In the Bombay Province, there are 1,681,205 sheep of which about 1,400,000 are located in the Deccan. Even very rough calculations show that if wool yield increased by one pound per sheep, it would mean an increased income of Rs. 5 lakhs per annum. Further, by better methods of shearing and marketing, an additional annual increase of a couple of lakhs of rupees is anticipated.

The site selected for the purpose of sheep-breeding work in Bombay is known as the Bhamburda Forest area, a low hill having an altitude of 2,000 ft. above sea-level. Research in Bombay has been undertaken with the object of producing a sheep yielding more and better wool and a better carcase. At the same time studies are made on mating, shearing, docking and castration and the husbanding of grazing resources. As elsewhere, attention is devoted to the teaching of better methods of shearing and wool classing, packing and marking of wool and the investigation of sheep diseases.

Though among Asiatic sheep the Deccani is regarded as a distinct breed, the type now available is ill-shaped and badly woolled owing

to neglect in selective breeding. The colour is generally black, with all the variations of red and blue roan mixtures. The black colour of the sheep is not permanent, for it degenerates into grey and roans as the sheep grow older. An all-white animal with pink muzzle and carroty hoof has poor stamina. Uniformity in quality of wool with even colour had, therefore, to be made the basis of selection of the Deccani flock, and a white-fleeced animal with mottled or black face coupled with dark hoofs was preferred for the foundation stock. In the experimental work now in progress the quality and quantity of wool yield along with the stamina of the animals are recorded for individual selection. The record of weights, measurements, health notes, along with photographic prints, is being maintained to show the changes from generation to generation.

The quantity of wool yield is easily determined, but not so the quality. The fleeces of farm animals are graded into three classes by the feel and the length of the staples. Out of the 40 animals at the farm in 1939-40, 13 carried first-grade wool, 19 second-grade, and the rest had rough, hairy wool.

Precautions needed

The work carried out so far under the Bombay sheep breeding scheme has shown that the Merino is adaptable to the Deccan environment, but certain precautions are necessary. The Merino should not be moved long distances in the heat of summer as this affects breathing, checks rumination and causes ill-health. During the hot weather the animal should not be reared on dry pastures alone. If green fodder is not available, provision should be made for silage so that the sudden change to green in the monsoon does not have any deleterious effect. Green lucerne should not be fed in the afternoon but as the last feed at night. Green fodder is best given with a mixture of roughage. Unlike the Deccani sheep the Merino grazes day and night when conditions are favourable. Owing to the deficient quality of pastures in this country, abundant green fodder of this type will not alone meet the requirements of wool growth of the Merino and it is advisable, therefore, to restrict grazing and stall-feed these animals.

During the monsoon the Merino should not be let out without a dry feed in the morning. Lambs should not be allowed to graze till they are two months old. They should be brought up on dry foods. Except in the hot season the animal should be dosed against worms every month. Ewes with lambs should not be allowed to move along with the rest of the flock. They require special feeding and less disturbance than the dry flock.

As the Merino rams are very excitable and go off their feed very quickly, they should be left with the ewes at night only and should not move along with the flock all the 24 hours. Shearing of the sheep should be so arranged as to have sufficient wool on the backs of the sheep in the summer.

Proper lambing time

In systematic sheep-breeding work the question of ascertaining the proper time for lambing is of utmost importance. Experience in Bombay has shown that 'the post-monsoon lambing is a fortune, winter lambing a worthy harvest, and summer lambing a calamity'. Oestrus periods (i.e. periods when ewes come in heat) in Deccan sheep and the corresponding lambing season are:

Oestrus periods	*Lambing season*
March-April	Post-monsoon lambing.
June-July	Winter lambing.
October-November	Summer lambing.

In regard to the control of ticks and other vermins in sheep, it has been observed that the use of hard water for dipping has a deleterious effect on the wool. It has been found that it is extremely important to use the right type of water if the fleece-bearing characters of indigenous sheep are to be improved. It is suggested that in regions where river water is not available, canal water should be utilized. The best time for docking is when the lambs are 14 days old. With the exception of one application of Stockholm tar in the beginning, no further treatment is necessary. During the hot season a little powder of talc on the tar keeps the wound dry.

An effective and useful prescription, which is in common use in South Africa against sheep maggot fly, has been tried with satisfactory results. The ingredients are :

Carbon-tetrachloride	10 fl. oz.
Oleum-picis	8 ,,
Carbolic acid	3 ,,
Ammonia (10 per cent sol.)	2 ,,
Gum (acacia or arabic)	2 oz.
Water	75 fl. oz.

It is suggested that this treatment should not be repeated when once the maggots have been removed and the wound presents a healthy appearance. Ordinarily one application is quite effective.

Besides the schemes in Madras, Bombay and the Punjab, the Imperial Council of Agricultural Research has approved of sheep-breeding research schemes in Kashmir and Mysore and a scheme of research on the analysis of wool.

In Kashmir it is proposed to conduct cross-breeding experiments with selected local ewes and imported rams such as Cheviot, Border Leicester, Merino and Wensley Dale. Experiments on stall-feeding in winter, and in sorting and grading of wool are also proposed. In Mysore special studies will be undertaken on the relation of feed to quantity and quality of wool, the relation of age to wool production, the effect of lamb-shearing on subsequent production and quality and the effect of one lamb a year against two lambs a year on the constitution, longevity and wool production of the mother and progeny. The effect of castration on mutton and wool will also be investigated.

Wool analysis

The scheme relating to the analysis of wool is being undertaken by the Technological Department of the Bombay University. Here, it is proposed to analyse the various quality factors of Indian wools, such as length and diameter of fibre, crimp, kemp, medullation and density. Another branch of inquiry is the applicability of existing technique in other countries to Indian wools and modifications thereof required in India. Other lines of investigation are the correlation of the various quality factors with one another and with spinning quality, and the analysis of type and quality of wool.

Conditions of sheep-breeding

This short description of the sheep-breeding research in progress or under contemplation should give an impression of the magnitude of the problem before the country. Backward though it is, the industry supplies the livelihood of a large number of people and contributes a significant proportion of the livestock wealth of India. Indian sheep are managed under various handicaps. They thrive best in areas with adequate pasturage and sufficient space for exercise. Stall-feeding, low-lying and inundated pastures, excessive humidity and heavy rainfall do not suit them. They are extremely susceptible to parasitic infestation. These aspects of sheep husbandry can, however, be easily coped with if attention is given to preliminary details before undertaking a scheme of improvement. With the varieties of equable climate and topography available in India, it should be possible to develop definite breeds acclimatized to particular environments and suitable for the rural economy of the country.

Indian sheep in Australia

After all, Australia built up its wool trade equalled by no other country from a foundation stock of Indian sheep. The first importation of Indian sheep there was said to be of such an inferior type as to give one an idea that they were incapable of any improvement. They were described as 'long-legged, flat-sided, razor-backed beasts with a covering more like hair than wool', and this description applies fairly well to many of the present Indian types of sheep. Yet this was the foundation on which the greatest sheep industry of the world was built and was brought about by the natural facilities of climate and pasture, assisted by patience, perseverance and good judgment of the colonists. Again Peru, having almost the same conditions as India, is now a wool-exporting country. There seems no reason, therefore, why India should not follow their example.

CONTROL OF GRAM BLIGHT IN THE PUNJAB

By

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THE history of the blight disease of gram (*Cicer arietinum*), which has been prevalent in the Punjab probably for over 30 years, furnishes an example of enormous losses that a single disease can cause to a farm crop. In this article an account is given of its investigation and the success achieved in providing effective methods of control in the form of sanitary measures and blight-resistant gram types.

Loss of crores

Gram occupies the largest area next to wheat in this province and, including Indian states, it is grown on about five and a half million acres. Its economic importance is indeed very great for the reason that it is the only remunerative crop that can be cultivated in the extensive *barani* (rain-fed) tracts. It is, therefore, the mainstay of the bulk of the farming population of these areas. The disease has been causing serious damage mostly in the North Punjab, particularly in the districts of Attock, Rawalpindi, Jhelum and Mianwali. For several years in succession, the gram crop in many localities such as Attock *tehsil* has been completely wiped out by this disease. At a moderate estimate, the loss caused by gram blight in the whole province amounts to about three to four crores of rupees every year.

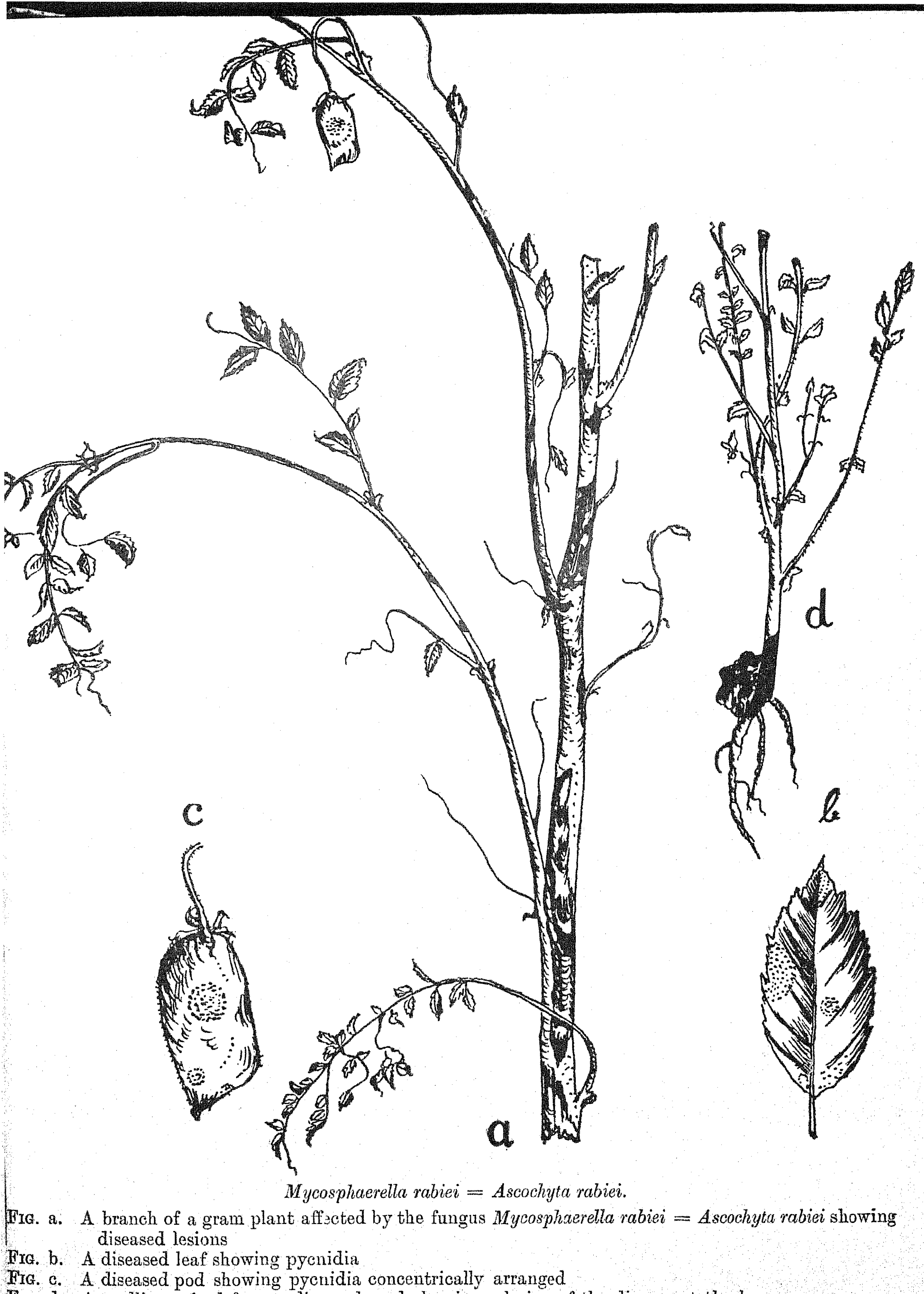
Although the disease has been in existence for several decades, its seriousness was not brought to the notice of the Agricultural Department until 1924. Its study was immediately taken up and the correct diagnosis of its cause was made in 1926. It was found to be a fungal disease and its causal organism was identified as *Mycosphaerella rabiei*=*Ascochyta rabiei*. This clear knowledge of the disease was due to the study of the diseased specimens collected on the spot in severely affected fields at Talagang (Attock). In 1926 the crop suffered most from the disease and was a complete failure.

For a few years, trials of 28 Punjab gram types were carried out in the field by growing them in the affected localities exposed to natural infection to ascertain if any of them possessed resistance to the disease. But they were all severely attacked by it. No useful results were obtained by treatment of the seed with either sulphur or copper carbonate before sowing. In all cases the disease broke out with as much intensity as in the farmers' crop. Up to this time the methods of investigation were more or less empirical. Nothing was known of the life-history of the causal fungus.

In 1932 the investigation was reorganized. A field laboratory was set up at Campbellpur in the heart of a severely infected locality and mycological staff was posted there to carry out the programme of research. The life-cycle of the parasite was fully worked out and its mode of perpetuation discovered. For the first time a paper giving a complete description of the disease was published in *The Indian Journal of Agricultural Science* in 1932.

Lightning attack

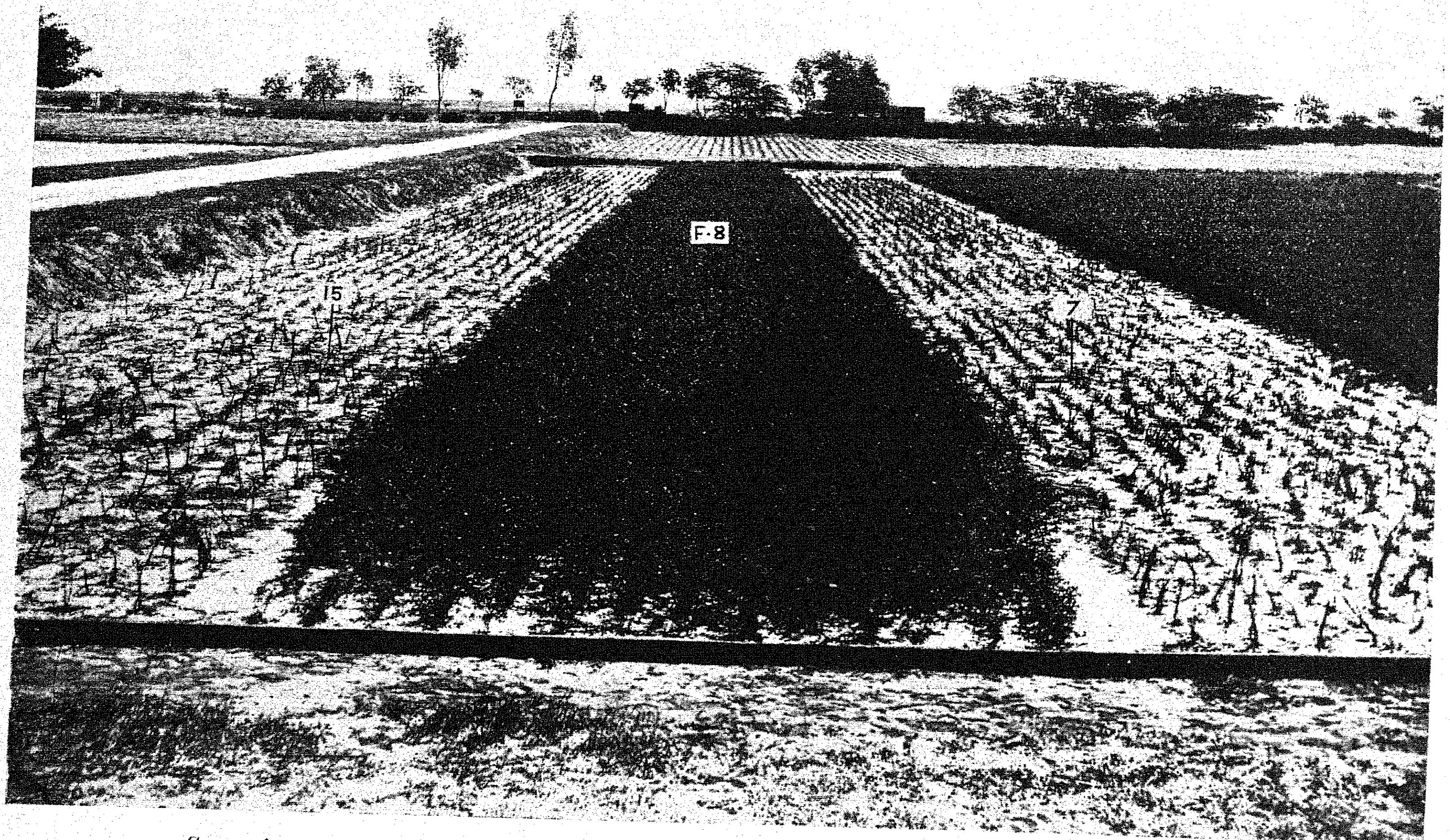
The disease attacks all the above-ground parts of the plant, i.e. branches, leaflets and pods. The roots are not affected. Dark brown spots are produced on the affected organs. On the stem the diseased spots are elongated and are about one inch or more in length. On the leaflets and pods the spots are in concentric circles. There are numerous minute black dots present on the diseased



Mycosphaerella rabiei = *Ascochyta rabiei.*

FIG. a. A branch of a gram plant affected by the fungus *Mycosphaerella rabiei* = *Ascochyta rabiei* showing diseased lesions
FIG. b. A diseased leaf showing pycnidia
FIG. c. A diseased pod showing pycnidia concentrically arranged
FIG. d. A seedling raised from a diseased seed showing a lesion of the disease at the base

[PLATE 19



Comparison of gram type F 8 resistant to blight disease with Punjab types 7 and 15 at Campbellpur

spots. These are spore bodies (pycnidia) of the causal fungus. Generally the diseased spots encircle the stem completely and the parts above them collapse and ultimately dry up. This is particularly noticeable on the terminal shoots which are found drooping. The disease can be recognized by the presence of a large number of lesions scattered along the whole length of branches from base to top (Plate 19). Usually the disease starts in patches scattered in a field wherever primary infection exists.

The incidence and development of the disease depends on the conditions of the weather. Wind and rain create favourable conditions for the dissemination and germination of the spores of the fungus and the disease spreads very rapidly by secondary infection from initially affected plants. Its attack is startlingly quick. It has been observed that a flourishing gram field is turned into a mass of dead plants within a fortnight. On the plants that may survive, the blight spots appear in abundance on the pods. The infection is transmitted from the surface of the pod to the developing seed. The testa as well as the cotyledons are affected. Every stage may be found from that in which the seeds are not formed at all to that in which they mature successfully but bear a diseased dark brown patch on the surface.

Modes of perpetuation

The disease is carried over from year to year by the following methods:

1. By sowing infected seed. Severely infected and shrivelled seeds are not viable, but the seeds which show only small discoloured spots germinate and 50-90 per cent of seedlings produced bear the disease.

Experiments have also shown that if seed mixed with pieces of infected gram material is sown and the seed-bed is fairly moist, the disease appears in the seedlings.

2. It has been found that the fungus remains viable for three years in diseased gram-plant debris which remains lying on the surface of the soil in the fields or on threshing floors, after the crop is harvested and threshed. The fungus present in such material initiates the disease in the succeeding crop.

It may, however, be mentioned that if the diseased material is buried underground during summer months at a depth of two inches or more and there is enough moisture in the soil the fungus is entirely killed and the remnants of the debris buried cannot infect the subsequent gram crop. This was a very important discovery as it disclosed the weak and vulnerable phase of the fungus. Experiments have also shown that the soil itself does not harbour the fungus.

Control measures

The following measures of control were finally planned, after giving them a thorough trial for three years at the Agricultural Farm, Campbellpur, and proving their usefulness in overcoming the disease.

(1) Use of disease-free seed supplied by the Agricultural Department (the freedom from blight infection of the seed is ensured by cultural tests).

(2) Elimination of the diseased material from fields by (*a*) harvesting the entire gram crop by uprooting by hand and thus leaving fields free of infection; (*b*) ploughing the fields once after the first shower of rain in summer with the Meston plough to bury the remnants of diseased plants; (*c*) sweeping the threshing floors and burying or burning the collected debris; and (*d*) not making *bhusa* stacks in the fields.

Thoroughness essential

These sanitary measures of control were recommended by the Department in 1935 and were practised on the Departmental Farm as well as in some zemindars' areas for three consecutive years with considerable success in checking the progress of the disease. On the Farm where cleaning up was thorough, a gram crop almost free from the disease was raised. The cultivators also who employed these measures of control were able to get a better return from their crop than before. Side by side with these operations steps were taken for examination of farmers' fields to locate infection and rogue out diseased plants. While the campaign for enforcing recommendations among the farmers was being carried on, it was noticed that in spite of coercion and

persuasion, the measures were not carried out to that degree of thoroughness which would preclude all possible chances of infection. In 1938, which was the fourth year of the introduction of clean-up measures, very favourable climatic conditions appeared and continued throughout the season. The disease broke out in epidemic form and covered vast stretches of the crop in a few months.

On enquiry it was found that infection came in from adjoining localities where clean-up measures of control were not adopted. For these reasons it was realized that the methods of control hitherto used would not succeed for obtaining complete control of the disease. Moreover, the area under gram is very vast and merges into the territory of the neighbouring North-West Frontier Province where also the disease has been prevalent for many years. In view of the conservative habits of the farmers of the tract, these circumstances were, however, anticipated and the alternative unfailing method of controlling the disease by resistant types was borne in mind. For this purpose, experiments for the discovery of blight-resistant types were proceeded with.

Discovering resistant types

In 1933 all the Punjab types and those got from other parts of India and from foreign countries, i.e. Italy, U. S. A., Mexico, Australia, Baghdad, Bulgaria, Egypt, Greece, Palestine, Morocco, etc. were grown at Campbellpur and subjected to inoculation tests. Up to this time, 392 types had been examined in this way for resistance to the disease. All these types were found susceptible and succumbed to the disease, excepting three out of those supplied by the Bureau of Plant Industry, Washington (U. S. A.), which gave indications of resistance. These types were reported to have been imported into America from Mexico and Europe. They have been named F 8, F 9 and F 10 to facilitate reference.

Only a few seeds of each type were supplied, and they were sown at Campbellpur in 1933. Some seeds failed to germinate. The plants of those that sprouted had poor growth. Only four or five of them reached maturity and set seed. In the following year the plants of all the three types were tested for resistance by inoculation with spore suspensions and by spreading infected gram-plant debris. They showed variation in vigour of growth and degree of resistance. Single plant selections were made of those that showed a high resistance every year. They differed in morphological characters and colour of the seed. F 8 has yellow seed with rough surface like Punjab type 7, but is larger, being one and a half times its weight. F 9 is white and smooth. It resembles the well-known Kabuli gram. F 10 is black with rough surface and irregular shape. Its seed is about twice the size of the common Punjab type.

F 8 conquers the disease

Type F 8, being similar to the local gram, was considered most suitable for introduction to combat the blight disease by substituting it for the local seed. Attention was, therefore, concentrated on it. In 1936 sufficient seed became available for carrying out yield tests. Its seed being one and a half times heavier, the seed rate was fixed at 24 seers per acre against 16 seers of the local type in order to ensure a comparable stand of the crops. Yield trials have given an average outturn of 13 md. per acre and this compares favourably with the outturn of leading Punjab types 7 and 15. It is significant to remark that this respectable yield was the achievement of resistant type F 8 in a tract where thousands of acres were totally devastated. The resistant type F 8 and leading Punjab types 7 and 15 have been grown side by side in replicated plots for several years for demonstrating their behaviour towards the disease after being subjected to inoculation tests. Every year there was confirmation of high resistance of F 8 and extreme susceptibility of the local types (Plate 20).

A great contribution

Having decisively proved the merit of type F 8, steps were taken to multiply its seed. In 1938, 60 md. of seed were raised. In 1939, we possessed 1,235 md. and were able to grow an area of 2,086 acres comprising some farms of the Department and those of big land grantees. The total produce obtained from

this area amounted to 22,032 md., giving an average outturn of $10\frac{1}{2}$ md. per acre.

The discovery of this type is a great contribution to disease-resistant strains of farm crops evolved in India. It is a sure means of overcoming the ravages of the blight disease of gram. The seed has been issued to the public for replacement of the local type especially in those areas where the disease has been an epidemic for many years.

WET AND DRY TERRACING IN ASSAM

By R. C. Woodford, I.D.D.
Deputy Director of Agriculture, Livestock, Assam

ALTHOUGH this is not my particular subject, I have become interested in it through the fascinating occupation of supervising a farm in the hills, and by natural inclination.

The question of soil conservation is likely to loom large in the policies of Assam in future years, as the prosperity of the numerous and increasing hill peoples, and the control of damage and loss due to floods in the plains, are closely affected by it.

Effective soil conservation

The preparation of land for the wet rice crop is, it seems to me, a most effective method of conserving the soil and retaining it where man has found it. It follows that the extension of the area under this crop is in itself a soil conservation measure ; and where a reliable annual food supply is also yet to be organized in hill districts receiving heavy rainfall, no crop could better answer the two purposes. Administrative officers of our hill districts realized this long ago and a campaign for the extension of wet rice terracing has been steadily carried on amongst the hill peoples.

The lesson is driven home to anyone having eyes to see who may visit the Naga Hills in July or August. Kohima, the headquarters of the district, lies in the country of the Angami Naga tribe, who are skilled exponents of wet rice cultivation in terraces. In this countryside one may see patches of terracing varying from one to a thousand acres in extent.

Terraces two feet wide are frequent, and on a steep hillside the drop between terraces may be five feet. The water supply is ingenious and efficient, sometimes being led round the hillsides for miles from the source to the fields. Sub-division of the supply is carefully controlled, and a large proportion of the court work of the Deputy Commissioner is concerned with water disputes.

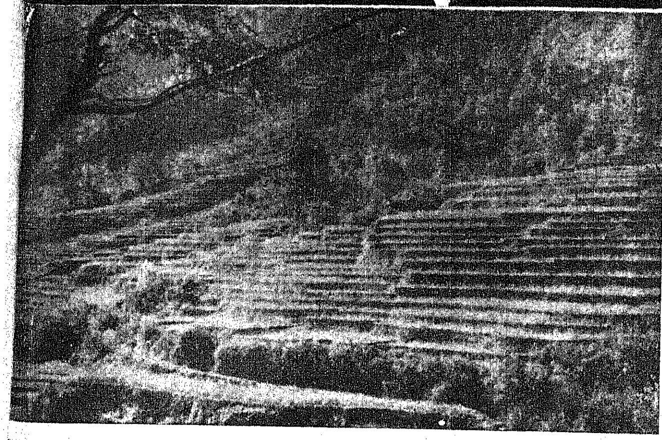
Varieties of rice are carefully grown and selected. There are said to be upwards of 40. Some for high exposed cold terraces ; some for the warm valleys ; some for this or that kind of rice beer, and so on.

Nature's gifts valued

The soil is good. Our Chemical Assistant tells me that he has recently made analyses which show excellent composition, in which phosphoric acid content is most noticeable. Nature has been kind perhaps but these people have conserved what Nature gave them. Amongst their terraces leguminous trees can be seen, which are lopped for green manure. In their dry terraces they never waste a tree ; they lop, but do not destroy. The Napalese alder is the outstanding tree for lopping in these parts.

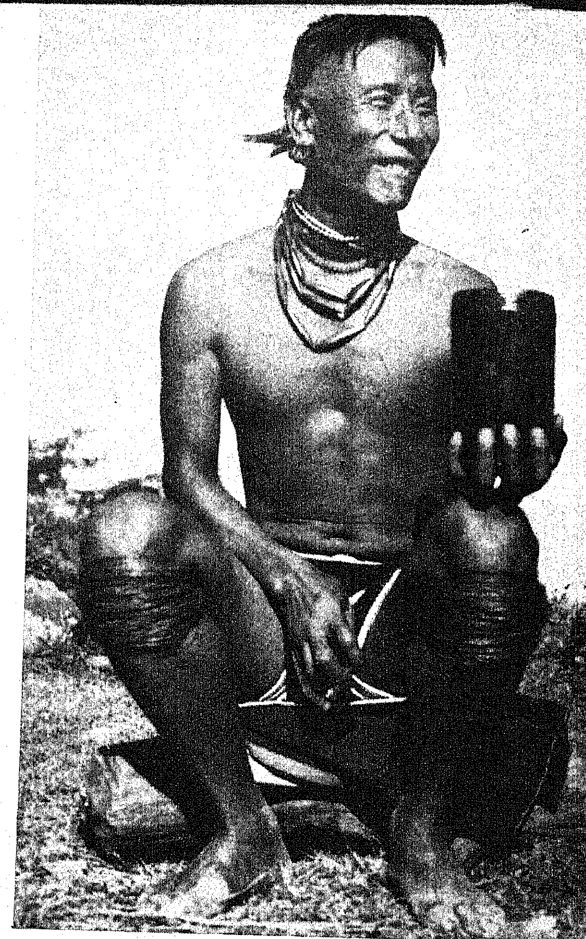
But only the Angami Nagas have this system of cultivation. None of the other Naga or other tribes had acquired it. Representatives of these others are occasionally sent to learn it, and several demonstrators are employed to visit them. The result is a gradual spread, and where terracing is adopted the food supply becomes steady and assured ; villages can increase in size which is important, as while in former days a growing village could throw off its surplus into new land, there is no space left now.

The Khasis and Syntengs who occupy the Khasi and Jaintia Hills cultivate wet rice on the flats of the small valleys. Their soil is poor and it was not until the introduction of bone-meal that they were able to get anything of a crop at all. In recent years wet rice cultivation has spread rapidly. In the Jowai subdivision the area under rice increased from 50,477 *bighas* to 67,461 *bighas* in the 10 years ending 1939.



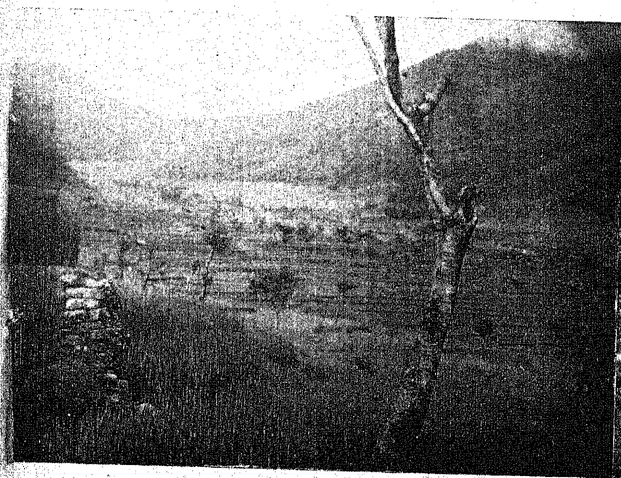
'raced wet rice in the Angami Naga country. Dry terraces h lopped Nepalese Alder trees can be seen running up the hill-side in the background.

Angami Naga village with its surrounding wet rice terraces

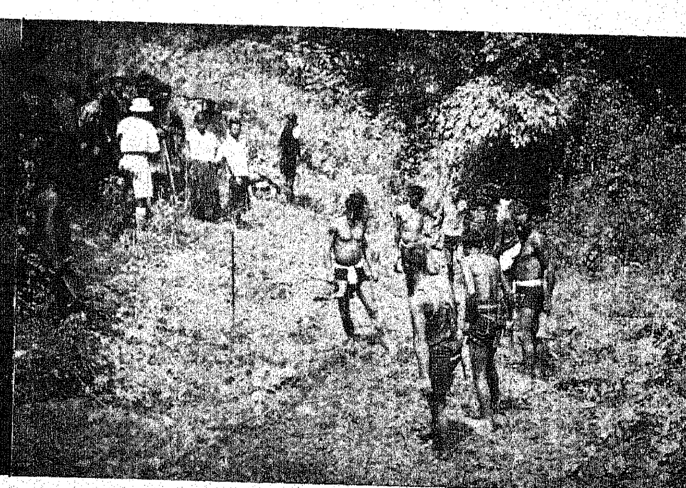


C. R. Pawsey, Deputy Commissioner, Naga Hills

Typical of the men who conserve the good earth. They sing in harmony while they work; and the last brew of rice beer was a good one. An Angami Naga



'ubza valley. Hundreds of acres of irrigated terraces, , beautiful piece of work. Note the leguminous trees lopped for green manure

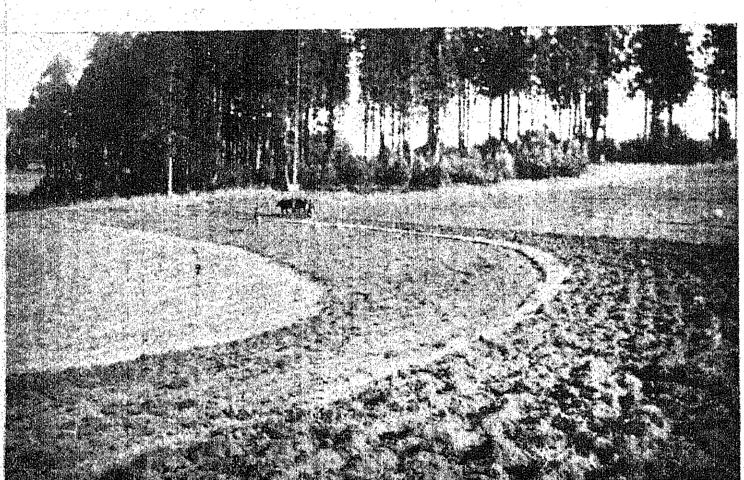


A demonstration of terrace-making. *Upper left*, a party of Abors from the Sadiya Frontier Tract. *Centre*, a working party of Angami Nagas about to begin.

An hour later. The terraces take shape and the people at the top are making the water inlet channel. Terrace-making here is an art with many rules to remember.

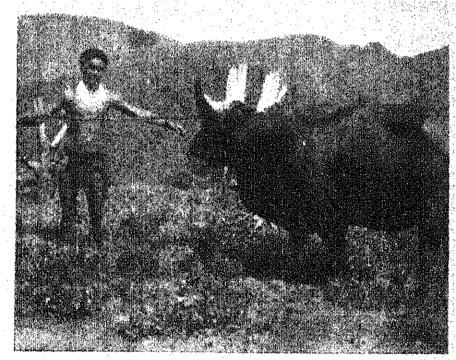
A grazing paddock in the Upper Shillong farm. Kikuyu under pine trees

[PLATE 22



The unploughed contour line in the first year

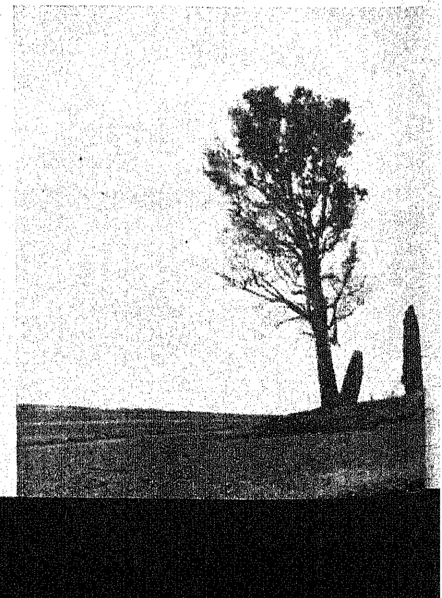
The contour lines become banks after the second year's ploughing. Bushes and young trees planted on the banks are barely visible at this stage



G. Stewart, Sub-divisional Officer Mokokchong,

Semi-domesticated Mithan. This is the distinct from the Gaur or Bison. They in with cattle and are valued for meat Hill tribes

Typical of the Khasi country. Ancest



As far as wet rice cultivation can meet the requirements of food supply and soil conservation in the hills of Assam, the situation is promising.

Dry terracing

But none of the hill peoples of Assam use the dry terrace, except the Angami Nagas already mentioned. Instead they use the *jhum* system which amounts, with local modifications, to cutting and burning patches of jungle, and sowing the crops in the ashes. When scanty population allowed a cycle of 30 years and upwards, this primitive system served them well and did little harm; but when, owing to increasing pressure on the land, the cycle comes down to seven or even five years with the promise of further decrease, disaster threatens, and is indeed with us now.

I find no explanation for the fact that while other hill peoples, such as those who occupy the Simla Hills and Nepal, use the terrace for rain-fed crops, the Assam hill tribes should not have adopted it. Is there some factor against it? Does the heavy rainfall cause such terraces to become waterlogged?

In order to learn how to operate terraces, and to demonstrate the soil-conserving value of the system, I have set myself to lay out the fields of the Upper Shillong Farm in contoured strips, and to adopt the other soil conservation measures which can accompany such a layout. I marked out contour lines with pegs, on a gentle slope making wide strips, on a steep slope narrow ones. All folds which formed gullies I left unmarked to be left untouched with their grass and shrubs to hold the surface. I then ploughed across the slopes following the contours, and between each ploughed strip along the lines of pegs I left a width of three feet unploughed. The plough turns the soil downhill and so each unploughed line soon becomes a bank. On a long slope I left an occasional complete wide strip unploughed and planted it with trees to form a windbreak, and to break up and hold the run of water downhill. Finally I am planting the banks between the strips with useful shrubs and leguminous trees.

Terraces are forming gradually. Each year's ploughing lowers the upper side of a strip and builds up the lower. The subsoil on the upper edges of the terraces is exposed only gradually and the trees, shrubs and grass of the banks deposit humus.

When a terrace is dug out in one operation, the top soil must be preserved and replaced on the terrace if anything is to grow within five years; but it is not possible to do such expensive work over a field of say five acres. Hence the importance of gradual exposure.

Such is the movement of soil downhill, either with plough or hoe (every man hoes with his back downhill) that three years' ploughing has produced banks three feet high. I realize that for rain-fed crops, we do not want flat terraces; a gentle slope on each terrace is better, as waterlogging under heavy rain is bound to occur in flat terraces. It will have to be dealt with when it occurs, but it should not be difficult.

COMMON DISEASES OF POULTRY IN INDIA—II*

By J. F. Shirlaw, M.R.C.V.S.

Imperial Veterinary Research Institute, Mukteswar

Fowl spirochaetosis

FOWL spirochaetosis is a fairly general disease in India and is usually fatal to young birds, particularly to those of highly selected strains. Older birds are considerably less susceptible to the infection than are young ones. The disease is caused by a blood parasite of the *Spirochaete* genus, which is carried from bird to bird by certain ticks (in much the same way as human malaria is spread by the mosquito). Its spread is facilitated by unhygienic conditions, such as badly constructed or wooden houses and overcrowding. The ticks, carrying the disease parasite, lurk in the cracks of wooden houses and, as they and their offspring may remain infected for long periods (up to three years), the disease, once established in a house, is likely to remain enzootic and a new stock to become infected on being introduced into the premises. Many birds of the air are susceptible to this infection and the possibility of their spreading the disease must not be overlooked. Apart from the direct bites of ticks, birds may become infected by eating them or their eggs, as well as by swallowing foodstuff contaminated by droppings from sick birds.

Symptoms.—The period of incubation is from five to nine days. The period of illness varies from three to five days in acute cases and up to 21 days in chronic cases. The onset of the disease may be so sudden that birds, apparently healthy at night, may be found dead next morning. The earliest symptoms to be discerned are dullness, drowsiness, ruffled feathers and loss of appetite. The temperature rises to 110°F and affected birds stand bunched together rooted to one spot, usually with their heads well hidden under their wings. The feet swell and the claws are retracted and turned inwards. The comb becomes limp and pale. Greenish diarrhoea early makes its appearance and gradually becomes more intense. Birds rapidly weaken, are unable to roost and, in an irregular manner, diverse forms of paralysis, spreading from the extremities, appear. Twenty-four to twenty-eight hours before death, the temperature suddenly falls (crisis) and the comb becomes bluish, and the bird soon lies helpless, spread-eagle on the ground, head held stiffly backward and to one side. Death occurs suddenly with convulsions. Mortality in this form is about 90 per cent. Chronic cases present similar symptoms spread out over a longer period with emaciation and are accompanied by a 60 per cent mortality rate. Fertilized eggs laid by infected birds are commonly infected and the developing embryo may die before hatching.

Avian coccidiosis

Avian coccidiosis is a serious disease of poultry, especially of commercial flocks, caused by a minute animal parasite (a protozoan) called a Coccidium. This parasite attacks the caeca (blind guts) of young stock (caecal coccidiosis), while it affects the duodenum and small intestines of older fowls (intestinal coccidiosis). The latter form of the disease is chronic, while the former is acute.

To understand the processes of the disease and the measures necessary for its control, an initial knowledge of the life-history of the coccidium is necessary. The organism completes most of its life-cycle within the intestines of the host (10-15 days), but it must pass a short time (at least 42 hours) outside the body before it can cause further infection. Fertilized eggs are voided in the droppings of infested birds. Under suitable conditions of warmth and humidity, the eggs divide into four definite bodies enclosed in a thick envelope. (Fertilized eggs may remain alive outside the body for as long as 18 months and still remain

* The first part of this article appeared in the January number of INDIAN FARMING, pp. 12-15.

infective.) When a healthy fowl ingests the parasite in food or water contaminated by the excreta of affected birds, its digestive juices dissolve the envelope and the parasites are free to make their way to the intestines, where they multiply and cause the condition known as coccidiosis. It is, therefore, obvious that, by proper sanitation, the life-cycle of this parasite can be broken and, when it is realized that a single fertilized egg may start a wholesale infection, it will readily be seen that the strictest precautions are necessary. It may also be pointed out that coccidia resulting from a single infection are entirely voided from the body of the host in 10 days and, if no reinfection takes place, the bird no longer harbours the parasite; so that, if the results of the one infestation are not unduly severe, it will recover. Control measures should therefore be directed towards preventing reinfestation by the most careful cleaning of the runs. If this is not done, the bird will continually take in fresh parasites in its food and drink. Fresh infections may, however, be introduced by wild birds, on the feet of visitors coming from infected premises, possibly miles away, and on the feet of dogs and nocturnal animals. Mismanagement and sudden changes in diet or weather conditions tend to increase the severity of the outbreak.

Symptoms.—In the acute (cæcal) form of the disease, the affected birds first appear listless, unthrifty and weak in their gait. This is followed by a discharge of blood from the intestines (consequent upon haemorrhages caused therein by the parasites) and rapidly increasing pallor of the comb and wattles. The birds generally lose their appetites, tend to seek the hover for warmth, stand bunched together and cheep much of the time. Whitish-brown diarrhœa is common and may paste up the vent region and prevent bowel movement. If the birds do not immediately (i.e. within two or three days) succumb to the loss of blood, subsequent inflammatory changes in the cæcum may prevent the absorption of food and so lead to extreme emaciation. The disease, however, may be so acute that chicks are found dead without having shown any signs of illness. At least 50 per cent of the victims of this form of coccidiosis die.

There is a tendency to confuse the chronic form of avian coccidiosis (intestinal) with tuberculosis. Adult birds have usually acquired some degree of immunity to the disease and consequently a considerable infestation by the parasite is necessary before any symptoms become apparent. Affected birds, on account of the interference caused to their digestion by damage to the intestinal wall, gradually lose condition in spite of a ravenous appetite. The combs become pale and the birds dull and dejected and they tend to take up positions away from the rest of the flock. Progressive wasting of the muscles causes drooping of the wings and leg weakness, and even paralysis, and eventually the sick birds are unable to stand. Death from this type of coccidiosis usually occurs in from one to three weeks, though the mortality rate is considerably lower than in the acute form of the disease. Survivors, however, which remain unthrifty, should be regarded as potential 'carriers'.

Coccidia may also attack the kidney (renal coccidiosis), the symptoms of this form of the disease are progressive emaciation, a staggering gait and loss of appetite. Finally the birds will roll over on their backs and death will shortly follow.

Coccidiosis should be suspected by the poultry-keeper when blood is observed strewn over the floor of the run and in the droppings, either in a natural or altered state. In a suspected outbreak, laboratory diagnosis is necessary but precautionary measures should immediately be put in hand to prevent further infection and losses. The appearance of the disease among older fowls is usually an indication of errors of management, interfering with the health of the birds.

Internal and external parasites

Worms, mites and lice in small numbers infest the majority of fowls without doing any perceptible harm, but under favourable conditions, this mild infestation may develop into devastating parasitism, capable of destroying a whole flock. Even where death does not actually occur, badly infested birds become unprofitable in the extreme. They grow unthrifty and emaciated, growth is retarded and egg production falls off.

Worms

Round worms are the most common of the internal parasites and when numerous they may seriously affect the digestion and, by irritation of the intestines, cause diarrhœa or constipation. Young birds are more seriously affected than older fowls. If the infestation is moderate, birds develop great thirst and a ravenous appetite. Heavy infestation is marked by loss of condition, anemia, digestive disturbances, loss of appetite and even muscular weakness. Worms reproduce rapidly. The female may lay as many as 50,000,000 eggs. These are voided in the droppings and may remain alive for a considerable period (up to five years). Outside the bird's body, they hatch into larvae (either in some intermediate host or in the open) and are ingested by other fowls.

Among the round worms, the following do most damage :

(a) *The Crop worm*, a long, slender worm, which infests the bird's crop.

(b) *The Stomach worm*, the male being long and thin, the female almost spherical and bright red after feeding. This worm infests chicks and causes swelling of the glandular stomach.

(c) *The Large Round worm of the Intestines*, which is very common. It gives off a poisonous excrement, which affects the health of the host. Infested birds lose condition and 24 per cent of them are likely to die within a few weeks.

(d) *Cæcum worms* are a normal inhabitant of 75 per cent of the fowls but do not become excessively numerous in ordinary healthy birds. Heavy infestation, however, causes inflammation of the blind guts and may cause death.

(e) *Gape worms* infest and impede the windpipe of young chickens, causing the condition known as 'gapes'. This is characterized by a wheezing cough, gasping and the expulsion of frothy saliva from the mouth. The bird constantly opens its mouth and shakes its head. Usually a lump may be found by feeling along the windpipe. The continuous effort to obtain air prevents the chick from feeding, and it will, consequently, die of general weakness, if not of suffocation. The gape worm is about an inch long and the male is permanently attached to the female forming a 'Y'.

Tape worms are flat, segmented worms, which invariably locate themselves in the intestinal tract. A heavy infestation of these may cause considerable damage. The most important of this group of parasites in India is the *Microscopic tape worm*, which is less than one-eighth of an inch long and passes a part of its life-cycle in slugs or snails.

Mites

Mites, as their name implies, are minute, black, eight-legged animals, usually no larger than an ordinary full stop. On a sunny day, they may be seen all over the feathers of a bird, causing their host to appear as if 'sprinkled with pepper'. They usually infest the base of feathers but some kinds actually burrow under the skin or even penetrate to the internal organs. They cause such intense itching that sitting birds will leave their nests, growing birds will become stunted, laying birds will fall off in their egg yield and all affected birds will become weak and even die as a result of the loss of rest resulting from the extreme irritation. Infestation is most common where sanitary conditions are poor, and may affect a whole flock causing a large number of deaths. The most troublesome of these pests to India are :

(a) *The Scaly-leg mite*, which causes the condition known as 'scaly-leg' or 'foot mange'. This mite burrows under the scales of the skin of the feathered portions of the legs and feet of fowls and causes minute quantities of straw-coloured liquid (serum) to ooze out from the perforations thus caused. This serum dries into scabs. In severe cases, the joints become inflamed and lameness ensues. Itching is intense.

(b) *The Depluming mite* infests the back, head and neck of the birds, causing 'depluming scabies'. Its presence in large numbers may be suspected when an abundance of loose skin scales pile up, feathers break off and the skin becomes denuded and coarse.

(c) *The Tropical (or feather) mite* rarely leaves a bird to which it has once attached itself, so that it will probably not be found in the nests. Numbers of these mites are usually to be seen in the fluff around the vent, where hundreds of eggs will be found, but may be observed crawling about anywhere among the feathers. They pierce the skin and suck their host's blood, causing intense irritation, anæmia, loss of condition and even death. Their spread may be assisted by birds of the air, by man or by dogs.

(d) *The Air Sac mite* is a very common small, light-coloured parasite, which lives in the air sacs and respiratory passages of its host and may cause serious disease, symptomatized by fits of coughing, partial suffocation and rattling in the throat. The comb, face and wattles appear blue, the bird becomes emaciated and droopy and severely infested cases usually die.

Lice

There is scarcely a bird that does not harbour lice of one sort or another but only heavy infestations of the biting variety cause serious damage. They feed largely on the skin and body secretions of the birds. Adult birds may support a large number of lice without apparent harm, save that their plumage becomes rough, their combs dark and shrivelled and egg production may decrease. Chicks, however, often succumb within a week or two to their infestation. These parasites produce considerable irritation and lousy birds will constantly pick at their feathers, appear sleepy, though unable to rest, and may refuse to eat. They also tend to wallow in the dust. Lice are most abundant in July and August and may be found particularly in the vent fluff region, though on parting the feathers, they may be seen running rapidly over the skin in search of protection. They are about one-twelfth of an inch long and have six legs. *The Body louse* is the most injurious species found in India. It is straw-coloured and prefers those parts of the skin that are not very densely feathered. They usually infest the heads of chicks. Lice can live for several months on a bird and a single pair is capable of reproducing 125,000 individuals within eight weeks. They deposit their eggs in clusters at the base of feathers. Lice cause much irritation and annoyance to affected birds, which lose weight, drop off in egg production and generally become unthrifty.

PROSPECTS OF CHEMICAL RETTING FOR JUTE

By C. R. Nodder, M.A. (Cantab.)

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THE ordinary ('rural') method of extracting jute fibre is very cheap and on the whole very satisfactory. Any conceivable process of chemical retting would certainly be much more expensive. There would be factory overheads, depreciation of plant and machinery, increased labour and supervision charges, power and, probably, fuel to pay for and perhaps water filtration or water treatment and possibly artificial drying, which is very expensive.

To justify the considerably greater cost of chemically retted fibre it would have to possess very pronounced advantages over ordinary fibre, such as greater strength, greater fineness, less liability to rotting, greater freedom from speck and bark, capability of being bleached more easily, and so on.

It seems out of the question to consider treating the whole jute stems as the cost even with the cheapest chemicals is likely to be prohibitive.

Economies

It would be necessary to 'decorticate' the dried, or partly dried, stems with a suitable machine and treat the crude fibre so obtained. The ratio of liquor to fibre would be between 5 : 1 and 20 : 1. Using the latter ratio 1,000 lb. of crude fibre would require 20,000 lb. of solution. If a 1 per cent solution were used (and it is fairly certain that no suitable chemical could be used in greater dilution) the quantity of chemical required would be 200 lb., and this is not likely to cost less than Rs. 12-8, or Re. 1 per md. of crude fibre. But the 1,000 lb. of crude fibre would yield perhaps only 600 lb. of finished fibre. The chemical cost on the finished fibre might therefore be Rs. 1-12 per md. If a lower liquor-ratio were used it is likely that the solution would need to be proportionately stronger.

Actually one treatment with any one suitable cheap chemical is not likely to give the desired result, and Rs. 3 per maund is likely to be the very lowest figure for costs of chemicals, per maund of finished fibre. No notable economies by re-use of solutions, recovery of chemicals or sale of by-products can be visualized at present.

This then is the probable minimum cost of chemicals alone. From experience with flax it may be suggested that the cost per maund of finished fibre for the other charges (depreciation, supervision and labour, power and fuel, etc.) would quite certainly be not less than Rs. 5 and might be anywhere between Rs. 5 and Rs. 20, according to the process and type of plant used. It is fairly certain that the chemically retted fibre would have to be sold at twice the cost of ordinary fibre at least to make even a small profit.

If the fibre produced could be sold at say £40 per ton when average ordinary jute was selling at £20 per ton it is possible that a chemical retting process might be workable. This is not necessarily an absurdly high figure for it is lower than the price of Italian hemp up to 1934 and far lower than the price in 1938. In a normal year good average flax sells at £60 to £80 per ton. If the chemically retted jute could replace these fibres for certain purposes there might therefore be a demand for it at £40 per ton, or even higher.

Hand-picking high quality jute

On the other hand one must take into account the fact that by hand-picking from high quality marks of ordinary jute it would be possible to produce a very high-class fibre, strong, fine and lustrous and free from speck, at a price far below £40 per ton in a normal year and it may be doubted if the chemically retted fibre would show many advantages over fibre so obtained. If best quality jute were chosen while it was *on foot* and taken

to a central rettery (which might be a stretch of river where retting conditions were very satisfactory) and retted there under careful supervision, it is extremely likely that fibre of very fine quality could be produced and subsequent hand-picking would yield a final product of superlative quality. Enormous quantities could be produced in this way more cheaply than by any conceivable chemical or mechanico-chemical extraction process.

Cost of chemicals

A word may be said about the chemicals that might be used in chemical retting. The question of price practically confines attention to the cheaper mineral acids and the cheaper alkalis—sulphuric acid, sodium carbonate, caustic soda, sodium silicate. Hypochlorite solutions might be possibly used in one stage of a process. Phosphates and all organic chemicals (except perhaps cheap soaps) appear to be ruled out by cost considerations. Ammonium oxalate has an excellent 'retting' action, but at say £90 per ton its cost seems prohibitive. Nevertheless one must remember the marvels that have been achieved in the way of recovery of chemicals and the utilization of by-products, particularly in paper manufacture. A chemical retting process permitting of similar recoveries may be found in future, but it does not appear to be available at present. In the case of flax good progress has been made in the chemical treatment of mechanically extracted fibre ('natural flax') after some of the preparatory spinning processes have been carried out, for example, by chemical treatment of the rove. After chemical treatment the rove can be spun to a good strong yarn up to 25's lea, very suitable for ducks and canvases, and no doubt passable yarns up to 80's lea can be produced.

To work jute on similar lines it would be necessary to construct 'decorticating' machinery suitable for dealing with the thick, hard jute stems, and further machines would be necessary to break down the coarse ribbons of fibre so obtained into fine strands. As compared with flax this problem appears difficult, but it may not be insoluble and it is on these lines that developments may be possible. A mechanically extracted fibre suitably softened and opened up by further mechanical treatment, might very well sell at a price not far different from ordinary jute. A modified 'Linra' Crimper-decorticator might prove suitable for the preparation of the unretted fibre.

Experiments on a jute softener show that freshly cut jute stems may be fairly satisfactorily 'decorticated' on such a machine. A modified machine with fewer rollers and the addition of beater blades is likely to be quite suitable.

Transport of the crude fibre is likely to be a problem. But in a suitably situated factory no doubt very considerable quantities of fibre could be treated without incurring very high transport costs and if there were special virtues in the chemically retted fibre it might have at least a limited demand for special purposes.

Samples of chemically retted jute produced by the Van Besouw process have been examined and appear to be satisfactory, but nothing is known of the production costs or the quality of the straw that was treated (for example, whether or not it was specky).

Chemical retting processes or mechanico-chemical treatments may one day come into their own, but everything will depend on the costs in relation to the enhanced qualities of the fibre, if any, and on the comparative costs of the product and of the fibres it might replace.

THE SOIL AND THE NEWER SOIL SCIENCE

By J. K. Basu, M.Sc., Ph.D. (Lond.)
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A FAMILIAR object like the soil hardly requires a definition to convey its precise meaning to the general reader. In a standard dictionary the meaning of soil is given as 'the ground, upper layer of earth in which plants grow, consisting of disintegrated rock, usually with the admixture of organic remains, mould, etc.' The soil nourishes all the living creatures by supplying the life-sustaining 'juice' for the vegetable kingdom from which the animals derive their food. Its close connection with agriculture is thus evident, and from time immemorial the soil has received its share of attention in the agricultural development of every country.

Shrouded in mystery

However, due to its inconspicuous nature and lack of individuality the soil has evaded for centuries the observing eyes of scientists. To quote Dr E. Ramann, the famous soil scientist, in this instance: 'The eye recognizes the plant world in its various aspects as forest, field, steppe or savannah; the animal kingdom attracts attention by the power of movement displayed by many of its members, but the soil is usually hidden from observation under a covering of living or dead plants. Even if the structure of the soil is revealed, as in a cutting, the eye lights more readily on the projecting rock than on the inconspicuous layer in which the roots of plants are distributed.' Thus the knowledge of the soil remained shrouded in mystery for ages during which period other branches of natural philosophy continued to make progress. It is only since the last quarter of a century that strictly scientific studies on the soil may be said to have been undertaken and the subject has now acquired the status of an independent branch of natural philosophy—the science of the soil,—or more appropriately termed Pedology.

In the earlier stages of the development of this science, the soil was looked upon by scientific men either as a medium in which plants grow or merely as a geological formation. An entirely new orientation has, however, been given to the subject by the Russian school of soil scientists who view soil as an 'independent, natural, historical body' capable of growth, development and decay, in a way comparable to a living organism. Hence, for studying the soil, its entire anatomy must be examined in a vertical cross-section just like dissecting a zoological or botanical specimen for examination. This 'cross-section', termed a 'soil profile', consists of the complete succession of soil layers or horizons down to the geological parent material from which the soil has been derived in the past. These individual soil layers can be compared to parts or members of a plant or animal. For a complete understanding of the nature of the soil profile, therefore, the different layers have to be studied in the field with regard to their sequence and physical characteristics—called the morphology of the profile—followed by a chemical examination in the laboratory. Before describing how this knowledge can be utilized for assessing the soil changes which find expression in the profile it is proposed to give the reader a general idea regarding the composition and constitution of the soil material.

Soil material

Briefly speaking, this consists of (1) mineral matter derived from the parent rock partly by mechanical disintegration and partly by chemical decomposition, and (2) organic matter consisting mostly of residues of plants that have grown over it in former times. These latter substances are most important as they supply the food and energy materials for the micro-organisms existing in the soil to function and synthesize the soil solution suitable for plant growth. This soil solution is usually

rich in soluble forms of nitrogen, potash, phosphoric acid, lime and other bases which form some of the important elements of plant food.

The mineral matter

This is composed of variously sized particles which, in nature, always tend to form aggregates of different patterns. The proportion of these different particles in the soil, which determines the 'texture' of the soil, is the result of a long period, perhaps centuries, during which time the soil has been subjected to disintegrating forces, and is thus beyond the scope of the farmer's activities in modifying the soil conditions to his advantage. The study of the proportion of the differently sized particles, called mechanical analysis, is important from the point of view of understanding the changes that the soil has undergone. The various fractions consisting of particles grouped within convenient limits of sizes, are termed sand, silt and clay and are also useful in indicating the likely field behaviour of the soil. It must be emphasized, however, that in nature there is really no abrupt change from one size to another, there being an imperceptible gradation into an infinite variety of shapes and sizes. The clay fraction is specially important as it contains very minute particles which are the most highly weathered part of the mineral matter and which are chemically reactive. This and certain other important properties of these finer particles in the clay are due to their 'colloidal' nature and will be discussed later under 'soil colloids'.

Now turning to the chemical nature of the soil minerals we may distinguish three groups of substances :

(1) *Bases* like lime, magnesia, soda and potash.
(2) *Sesquioxides*, i.e. oxides of iron and aluminium.
(3) *Silica*.

Proportions of these groups present in the weathered portion of the soil indicate the extent of soil weathering. In an arid climate the bases predominate and the ratio of silica : sesquioxide is higher while under humid conditions the base contents of soils as well as the silica : sesquioxide ratio are usually low.

The organic matter

The organic matter of the soil, popularly known as humus, is a dark-coloured, structureless material and forms from less than 1 per cent to 10 to 15 per cent of the total weight of soil. It is one of the most important constituents of the soil as it imparts all the desirable qualities to a soil, such as pore space, moisture-holding power and good tilth. In nature the soil organic matter is derived entirely from plant residues and in the case of cultivated soils partly from plant residues and partly from organic manures added to the soil. Conversion of the organic matter to humus takes place through the agencies of bacteria and fungi and the process is called 'humification'. There are different types of humification under different soil conditions and the products are variously known as 'acid humus', 'peaty humus', 'raw humus' and 'mild humus'. Formation of different types of humus greatly alters the soil-forming processes, a subject which will be discussed later in the course of this article.

The soil colloids

Ninety years ago, Thompson and Way in England, while investigating the loss of ammonia from manure heaps, observed that soil had the property of absorbing ammonia and that, when sulphate of ammonia was added to the soil, it could not be washed out with pure water. This action was imperfectly understood at that time and is now attributed to a peculiar property of some portion of the clay and the humus. This portion, which is chemically reactive, owes its properties to the 'colloidal' or very finely subdivided condition in which it exists. The 'colloids' or substances in a colloidal state consist of jelly-like substances composed of very minute particles, some of which are so small that they cannot be seen under an ordinary microscope and, when suspended in water, remain indefinitely in that state. Further, these particles carry a negative electrical charge and by virtue of this property and because they present a very large surface area they can retain positively charged bases like ammonia, potash, soda, lime and magnesia (some of which are useful for plant nutrition) against the leaching action

of water. Thus they are the natural 'storehouses' of plant food in the soil. Colloidal clay and humus are the chief among these constituents which form what is called the 'clay-humus complex' or the 'absorbing complex' or the 'colloidal complex' of the soil. The absorbed bases, however, can be replaced by the addition of any salt or acid solution to the soil and are for this reason called the 'exchangeable' or the 'replaceable bases' and phenomena of such exchange, 'base exchange'. The bases are usually made available to the plants by the carbon dioxide evolved by the plant roots or by bacterial activity.

The most remarkable fact which has been brought to light in recent years is that the nature and amount of these exchangeable bases in combination with the absorbing complex have a very pronounced effect on the physical properties of the soil. The preponderance of calcium base (lime) imparts the most desirable properties from every point of view, causing the soil easily to form and maintain good tilth, and in all other ways to provide for the best conditions for plant growth. On the contrary, a soil saturated with an excess of sodium is extremely sticky when wet, forms hard clods on drying, cracks violently and altogether provides an unsatisfactory medium for plant growth. Beyond a certain limit of sodium saturation these soils are totally infertile, where even grass can hardly grow. Such soils are called alkaline soils, and their reclamation is carried out by the application of the well-known principle of 'base exchange'.

Soil structure

The natural tendency of the soil to form aggregates has already been referred to above. Such a state of aggregation of primary soil particles is termed the structure of soil. The clay-humus complex is chiefly instrumental in inducing the soil to form aggregates and the role of exchangeable bases in influencing the type of structure has been discussed before. Structure study is, therefore, an important aspect of the morphological examination of the soil profile. It has been developed to a great extent of late and a systematic nomenclature to describe the shape, size and behaviour of aggregates has been devised. From the practical point of view also the formation and maintenance of a suitable type of aggregate is an important item in successful soil management. The most desirable type of structure to be aimed at is crumb structure which is conducive to what is described as good tilth. Tillage of the soil, which is instrumental in bringing about this desirable state, is an art which has been developed to a high state of perfection in most countries with long established traditions. However, the scientific study of tilth is only recent, though already quite a good deal of work has been carried out on this subject resulting in a number of ingenious methods for quantitative determinations of this property and its bearing on agricultural problems.

Soil profile and soil type

All the soil-forming processes that have undergone in the soil in the past find their true expression in a soil profile. In it the influences of climate, geology, vegetation and topography are reflected and by studying the different soil layers we can arrive at a clear understanding regarding the origin, nature and reactivity of a given soil. Now the most far-reaching changes in a soil are brought about by the action of the percolating water, called the 'soil leaching', in effecting a separation of soil constituents which are, in fact, the products of soil weathering. A soil profile thus consists of: (1) The surface soil, from which the products of soil weathering are removed by the percolating rain water, is called the Eluvial or the A-horizon—the horizon of impoverishment. (2) The sub-soil, where these washed materials are deposited, is called the Illuvial or the B-horizon—the horizon of enrichment. (3) The underlying soil layer which remains unaffected by the action of percolating water is called the C-horizon. Further sub-divisions of the A and B horizons are done on the basis of subsidiary characters of these soil layers. This system of a three-fold division of a soil profile is due to the Russian investigators and is in use in all recent pedological work. The four important soil constituents which have already been mentioned

exhibit characteristic variations in their depth distribution in a profile under different sets of conditions and actually determine the various soil types. They are (*a*) bases, (*b*) sesquioxides, (*c*) silica and (*d*) organic matter.

Four sets of conditions

The following sets of conditions may be considered here :

1. Under arid conditions, where the rainfall is outweighed by evaporation, there is very little free water which can percolate through the soil mass and the products of soil weathering remain in the upper soil layer, and consequently differentiation of the weathered layers into A- and B-horizon is not distinct. Due to lack of moisture weathering is mainly physical, and want of a vegetative cover makes the soil very poor in humus. Typical examples of these soils are : *desert soils* and *brown and grey soils of the semi-desert.*

2. In a semi-arid climate, where alternating wet and dry conditions prevail, alkali soils are formed. Due to heat and wetness chemical weathering goes on at a rapid rate for part of the year and products of soil weathering, viz. salts of the alkalis and alkaline earths, accumulate in the profile. *Solonetz* and *Solontshak* soils are the main types in this group. In India soils belonging to these groups occupy a considerable area and are known as *usar*, *reh* or *kallar* soils in northern India and *chopan* or *karl* in the Deccan.

3. Where the rainfall is slightly higher, free bases like calcium carbonate and gypsum are washed out from the surface layer and are deposited in lower soil layers. Here the soil colloids are still saturated with bases (mainly with calcium). Due to excellent grass type of vegetation the soil gets enriched in mild humus. These soils are fertile and possess excellent tilth. Soils of this group are called *Tschernosem*. Investigations on the well-known black cotton soils, also known as *regur*, which occur extensively in India, have shown that they bear a close relationship with this group of soils.

4. With further increase in rainfall not only the free bases are washed out of the soil profile but the exchangeable bases are also partly removed, and the soil complex gets unstable. The breakdown of the complex takes place to a certain extent and if there is no appreciable washing down of either silica or sesquioxide, the so-called *brown earths* are formed. In a cool and humid climate, if on account of acid humus formation sesquioxides are washed out and are deposited in the B-horizon, a *podsol profile* results. On the other hand in a hot and humid climate silica may be leached out, leaving an excess of sesquioxides in the profile. In such cases *red soils* and *laterites* are formed. Red soils and laterites occur in the hot and humid tracts of India, viz. Assam, Madras and the West Coast of the Peninsula.

A rational system

We have seen how, by following the new concept of the soil as an ' independent, natural, historical body ' and the soil profile as a unit of study, one can arrive at a rational system of soil classification. These groupings of soils into different types according to the profile characteristics are comparable to the classification of animals or plants, and just as every organism shows an adaptability to its external environment, so each soil type is expected to respond in a given fashion to manuring and cropping. On the basis of this conception all the field experimentations on agricultural crops are now being conducted in the more advanced countries of the world. In this connection the importance of soil surveying and soil mapping on this basis can hardly be overemphasized. Thus the eminent British soil scientist, Sir John Russell, says : ' One of the striking services that soil science has rendered in recent years has been surveying the soils of the different countries and in the preparation of maps on which any desired part of the information can be represented. This is now recognized as an essential preliminary to all agricultural developments, reclamations and irrigation schemes, and it forms an integral part of any organized development of agriculture such as it is now being carried out in many of the countries of the world. To start an important agricultural development without a preliminary soil survey is to run serious risk of disaster.'

The study of soils is still in its infancy in India. There has been lately a growing interest

in pedological studies in certain quarters due to the activities of the Indian Society of Soil Science. In an agricultural country like India the creation of a 'soil consciousness' is essential among all classes of people and for this reason the subject should be introduced in schools and colleges. There should be extensive propaganda among the cultivating classes by means of demonstration centres and classes showing the different soils of their locality and the best way of managing them. This will ultimately lead to a better utilization of the immense resources of the land which is a trust in the hands of a nation, to be carefully maintained and built up for themselves and for posterity.

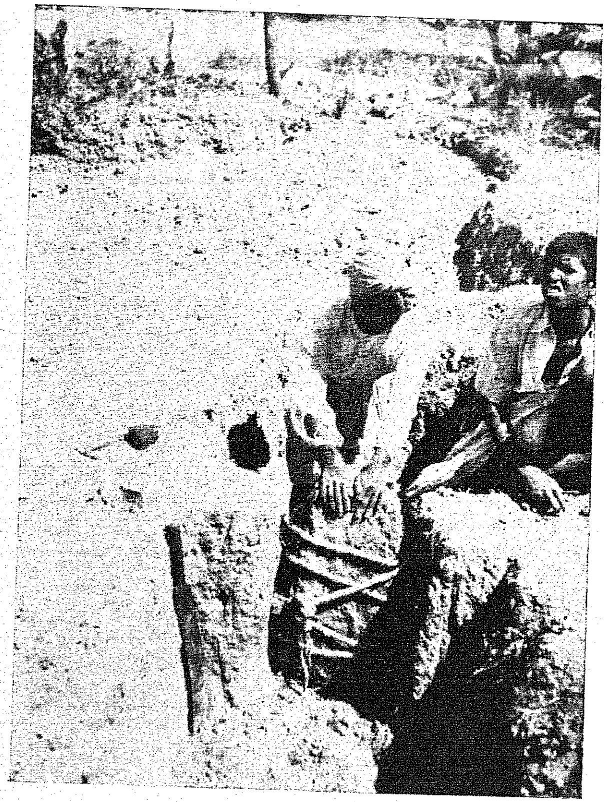

FIG. 1. Collecting a monolith, i. e. a specimen of a soil profile for the museum. A soil block 9 in. broad and 2 in. thick and of sufficient length to show the important horizons is preserved in a box with a glass front.

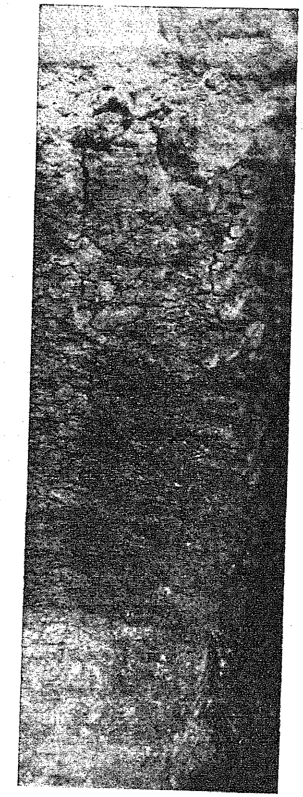

FIG. 2. A typical profile of a black cotton soil from the Padegaon Farm, showing the characteristic horizons.

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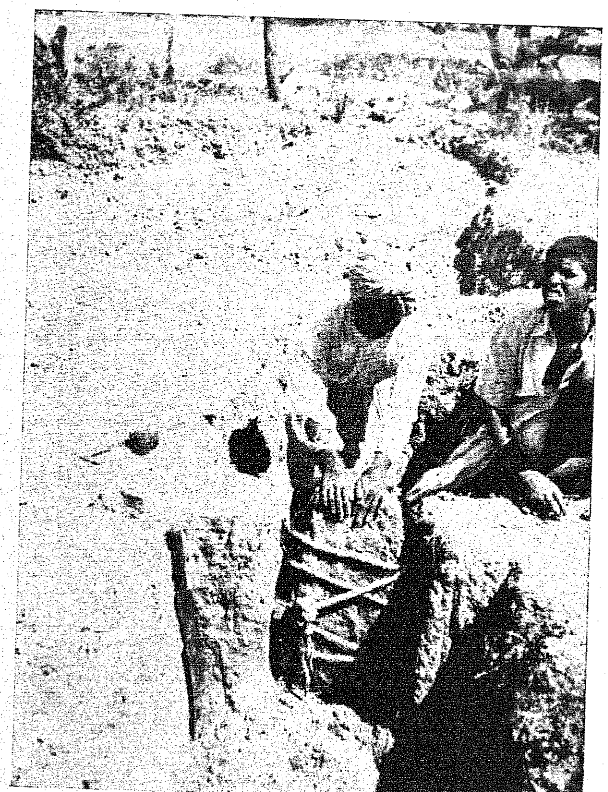


FIG. 1. Collecting a monolith, i. e. a specimen of a soil profile for the museum. A soil block 9 in. broad and 2 in. thick and of sufficient length to show the important horizons is preserved in a box with a glass front.

A (20 in.) — Dark grey with brown shade, clay loam :
(a) Large clods (2-3 in. dia.)
(b) Smaller clods ($\frac{1}{2}$-1 in. dia.)

B_1 (24 in.) — Mottled brown and black horizon, brown increasing downwards, silt loam.

B_2 (16 in.) — Reddish brown colour with patches of white limy and silicate material. More compact than above, clay.

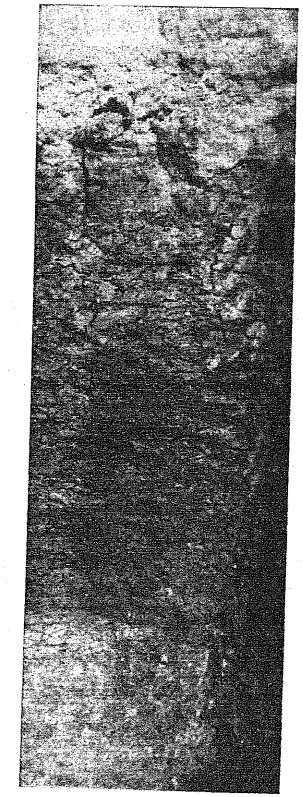
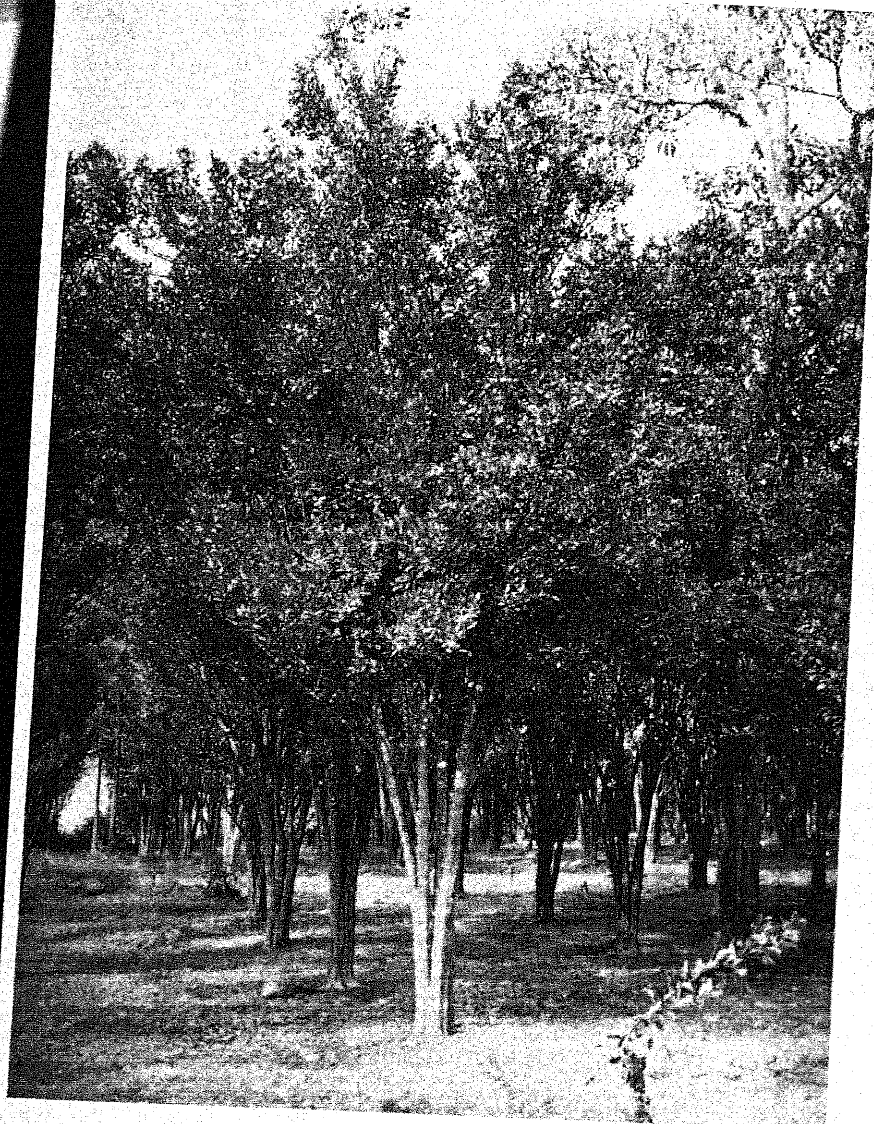


FIG. 2. A typical profile of a black cotton soil from the Padegaon Farm, showing the characteristic horizons.



Bordeaux-mixture sprayed plot of Coorg orange in Wynaad (Malabar)

View of a control unsprayed plot showing defoliation

What the Scientists are doing

TWO NEW CAMBODIA STRAINS

THE Cambodia strain—Co 2—which is being grown over 275,000 acres in Madras suffers from the disadvantage of being long in duration. With a view to removing this defect and thereby reducing the cost of production, it was crossed with two early maturing South African strains, U 4/4 and A 12. As a result of examination of their progenies, two strains ×3915 (now named Co 3) and ×4383 (now named Co 4) were isolated recently and compared with Co 2. These have been found to thrive better when sown in February-March and to be earlier than Co 2 by three weeks. Besides, their yields are distinctly higher than that of Co 2. Their lint has been declared by the Director, Technological Laboratory, Bombay, to be much superior to that of Co 2. They were grown over 1,000 acres during the year. Their lint fetched in the open market a premium of Rs. 125 per candy of 784 lb. on the price of Broach cotton. The growers are benefited to the extent of at least Rs. 25 more per acre owing to the better prices paid for the superior quality. Their seeds are now in very great demand.

Strains	Yield in lb. per acre (1938)	Lint length (Baer sorter)	Ginning percentage	Highest counts spun
×3915 (Co 3)	1,545	1·04″	36	44's
×4383 (Co 4)	1,651	1·10″	31	42's
Co 2 . .	916	0·97″	33	34's

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PHYTOPHTHORA DISEASE

THE loose-jacketed Coorg orange (*C. nobilis*) is grown extensively as a rain-fed crop on the hill slopes of Coorg, Madras and Mysore at altitudes varying from 1,500 to 4,000 ft. The crop is, however, subject to a serious disease caused by a species of *Phytophthora* in tracts of heavy rainfall. The fungus attacks the leaves, young fruits and the bark of the stem. The attack usually begins during July and heavy leaf-fall and fruit-drop occur during the peak of the south-west monsoon. Towards December-January, when dew and mist are heavy in the hill districts, the fungus attacks the bark of the stem causing cankerous wounds on the trunk and branches. Spraying experiments conducted in the Wynaad hills (Madras) have shown that the three forms of the disease can be effectively controlled by two sprays of 1 per cent Bordeaux mixture (5-5-50), the first to be given in May-June just before the outbreak of the monsoon, and the second during July when the fungus is most active. The mixture should be applied liberally so as to cover the stems also. Scraping the wounds with a sharp scraper and painting them with Bordeaux paste prevents the spread of the bark canker.

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NEW INSTITUTE AT ANAND

IN June 1939 the Bombay Government received two valuable donations for agricultural and animal husbandry education. One was a sum of Rs 9 lakhs from the Sheth Mansukhlal Chhaganlal Trust and the other the sum of Rs 6 lakhs from the Sheth Mungalal Goenka Trust. With the help of these donations it was decided to establish and maintain the Mansukhlal Chhaganlal School of Animal Husbandry, Dairying and Agriculture and the Mungalal Goenka Institute of Animal Genetics and Nutrition. Both these institutions are at Anand (Bombay Province) and they will have at their disposal a farm of a thousand acres at Anand. The Institute has the Chharodi Northcote Cattle Farm with its 2,000 acres of land and 500 head of cattle. There will be further a 100-acre farm at Surat.

The Mansukhlal Chhaganlal School is being established to give practical training in agriculture, including cottage vocations, animal husbandry, dairying, horticulture, etc. with elementary knowledge of science. It is proposed also to give instruction in rural reconstruction and to equip students for village service and leadership. The aim is to develop

and maintain in the villages intelligent men and women who gladly accept the conditions of rural life.

Short courses in specialized types of agriculture, for example cotton-growing, horticulture, dairying, etc., will be given for adult farmers. Those attending such courses will be given free accommodation, and no fees will be charged.

The school will also serve as a depot for the supply of improved seed and implements, manures, etc. The nursery will be used to grow seedlings for issue to cultivators in order to encourage tree-planting in villages. Agricultural shows and visits by cultivators are also included in the programme.

The programme of research includes a scheme for working out an economic holding with suitable subsidiary industries.

The Mungalal Goenka Institute of Animal Genetics and Nutrition has for its objects the development of pedigree herds of the best milch and draft cattle, research in dairying, animal breeding and nutrition and the popularization of improved methods. The herd at the Institute will be sufficiently large to meet the requirements of education and research.

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PERIODICITY OF LOCUST INVASIONS

LOCUSTS are well-known pests of crops in many parts of the world, and their ability to fly long distances and their propensity for making sudden onslaughts on cultivation in enormous hordes render them dangerous foes of agriculturists, said Rao Bhadur Y. Ramchandra Rao, M.A., F. R. E. S. in his presidential address to the Entomological Section of the Indian Science Congress held at Benares in January. There are many different kinds of locusts, some of which are peculiar to particular parts of the world. In India there are three species, of which the Desert Locust is the most serious. It usually invades the north-western parts of India, such as Sind, Baluchistan, the Punjab, Rajputana and the United Provinces, but in years of very heavy attacks its swarms have penetrated as far as Assam in the east and parts of Madras in the south.

It has been found appearing in fairly distinct cycles in India, each period of infestation lasting four to nine years. There have been about seven locust cycles since 1860, with intervals generally varying in duration from one to three years, but in some cases extending as long as six to eight years.

Study of locust movements

Formerly the invading swarms were believed to originate in Persia or Arabia, pursue an eastward direction in India, and ultimately die down here after breeding for a few seasons. A close study of locust movements in the last cycle of infestation, 1926-31, has served to give a good idea of the origin, progress and breakdown of locust cycles in the Indian area. A new cycle would appear to start as the result of heavy and concentrated breeding of solitary locusts in the desert areas of India and Iran. During years of infestation, swarms pass the winter in an inactive condition in the warmer areas (such as the south of Mekran) and become active again during the spring months. Swarms usually move northward in spring to Baluchistan and breed wherever good winter rainfall has occurred. Similar breeding also occurs in the Punjab, and the western part of the United Provinces. From May onwards, the interior of Baluchistan becomes an area of summer drought, and the new brood of fliers bred there migrates eastwards into Sind, the Punjab and Rajputana in early summer. With the onset of the monsoon rains, they breed there, and the new generation is ready to fly in the autumn. With the withdrawal of the monsoon, the Rajputana desert, as well as north-west India in general, becomes an area of dry heat, and the swarms tend to leave these areas and fly east, south, or west with the winds then prevailing. Whereas the swarms moving east into Bengal and Assam, or south into the Central Provinces or Bombay, gradually die away and are unable to breed, those flying west into Baluchistan and Iran are able to breed again in the following spring, and reinfest the Indian provinces in the summer months. The ability of the swarms in any particular year to fly westwards in autumn

and winter would appear to a large extent to determine whether the infestation will be carried into the succeeding year. When either winter rainfall in the west or monsoon precipitation in the east fails, there is usually a considerable diminution in the number of swarms, and a complete breakdown may often follow.

Close observations made during the swarm-free period commencing from 1932 have shown that the locust generally lives in the solitary condition in the desert areas of southern Baluchistan and the Sind-Rajputana region. Its habits of feeding and breeding are just like those of the gregarious locust. It breeds twice in the year, the first brood being in the western winter rain areas, and the second in the monsoon rain areas of the Indian desert, migration from one area to the other occurring at the change of the seasons. With good rainfall, the solitary locust breeds extensively, and if a second brood follows rapidly and concentrated egg-laying also occurs, incipient swarms are formed. Generally such outbreak centres are developed in the Mekran areas in the spring, and when the new brood flies into the desert areas in early summer and breeds here intensively on the fall of good monsoon rain, swarms are produced, and a new locust cycle is ushered in. A study of the mode of origin of past cycles has shown that heavy winter rainfall followed by heavy and well-distributed monsoon rainfall is the main factor in the swarming of the desert locust. Such was the case in 1926, in 1911-12, and in 1900. The fresh swarms reported recently in the Punjab, north Sind and Baluchistan would appear also to have had a similar origin.

The best way to prevent new outbreaks would be to detect the incipient swarms as soon as they are formed in the desert areas in Baluchistan and Rajputana and destroy them before they can fly out of the area. For this, however, a sufficiently adequate scouting staff and funds would be needed, and any expense incurred in this connection should be considered to be a sort of crop insurance for the ryot.

Of the two other locusts, the Bombay Locust, which is liable to break out and infest the areas of peninsular India, especially the Bombay Province, has been quiescent during the last quarter of a century. Unless it is thoroughly studied in its solitary phase and the nature of its outbreak centres investigated, it is considered likely that an outbreak of this locust might take place all at once and take the country by surprise.

What would you like to know?

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section will be reserved for replies to selected letters in cases where it seems that the information might be of general interest.

Q : Can iron filings be used as manure to provide iron to garden plants ?

A : Good colour in fruits and flowers has in the past been attributed to an abundance of iron compounds in the soil. When facts are closely examined, there is little support for such a theory. In the first place, the plant requires very little iron. As a rule, not more than 1 per cent of the ash of a plant consists of oxide of iron, so that the amount of oxide of iron taken from the soil even by a heavy crop specially rich in iron only amounts to about 10 lb. per acre. It is very seldom that a soil does not contain 2 per cent (or 20 tons per acre in the top 9 in.) of oxide of iron, a considerable proportion of which, being soluble in the weakest acids, is available to the plant. In view of the very small quantity of iron required by plants, it is rarely necessary to use iron compounds as manures. Indian soils usually contain sufficient iron for the use of plants. Experiments conducted by a well-known scientist upon apples gave purely negative results, and from those conducted with carnations, no positive conclusions could be drawn.

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Q : Can sawdust be utilized as manure ?

A : Sawdust is a very resistant and refractory material and cannot be easily converted into useful manure. It has, however, good absorptive capacity and can, in conjunction with grass, dried leaves, etc., be used as bedding for animals. A small proportion of sawdust can also be added to the dung while storing it in manure pits. Cattle manure prepared in this way will, on account of its porous nature, be found to be particularly useful in the case of heavy and sticky soils.

Q : What exotic fodder grasses and legumes could be introduced in the grazing grounds in the dry deciduous forests in the plains of India to increase the yield as also the quality of fodder from them ? What would be the best and cheapest method of regrassing the depleted grazing grounds with these species ?

A : Research has been going on for some years now with the object of trying to find exotic grasses which are suitable for introduction in the different forests of India for the improvement of the yield and quality of fodder from them. No grass or legumes has so far been found that can compete with the local grass communities, unless helped continuously by the hand of man. Certain species of grasses can be successfully introduced and maintained by a process of continuous cultivation, but this is generally out of the question as a practical measure over large tracts.

The first stage in improving depleted grazing grounds is to remove the cause of their depletion which is the excessive number of grazing animals they are expected to support. No improvement measures, whether by the attempted cultivation of exotic species or by the much cheaper method of encouraging the indigenous fodder grasses of the country, will be successful until the number of the cattle grazed is reduced to what the pasture will stand. This number varies with conditions, but is rarely more than one cow per two acres, and will be lower on badly depleted pastures.

Having ensured that the results of any attempts to improve the pastures will not be immediately frustrated by overgrazing, steps may be taken to bring the pastures back to a better condition. Overgrazing results in an increase in the number of weeds and in the proportion of coarse inedible grasses. It is

found that in dry deciduous forests, closure to grazing for three or four years results in the reverse process, good fodder grasses re-establishing themselves naturally to a great extent. A noticeable improvement occurs even after two years' closure, and if money can be spent on weeding out the coarse grasses, the improvement will be accelerated. When the pastures have been brought back to a more normal condition, properly controlled rotational grazing with a properly limited number of cattle or preferably grass-cutting with stall feeding in the forest, will maintain the pastures in good condition.

With our present knowledge of the subject, far greater improvement in the production of good fodder grasses will be obtained by such means for the money spent than will be achieved by attempting to introduce exotics which experience hitherto has shown cannot be maintained without continuous and expensive cultivation and, of course, similar control of number of grazing animals.

Of exotic fodder grasses and legumes tried, the following have shown some promise : Elephant grass (*Pennisetum purpureum*), Guinea grass (*Panicum maximum*), Sudan grass (*Andropogon sorghum* var. *sudanensis*), Rhodes grass (*Chloris gayana*), *Setaria sulcata*, Berseem (*Trifolium alexandrinum*), Lucerne (*Medicago sativa*). They can be introduced by ploughing the land and either sowing seed or planting tillers (seed and tillers are available from most agricultural farms in different provinces where advice on the species and methods of cultivation most suited to the locality may be obtained). The grass plots will have to be regularly weeded to prevent indigenous grasses, both edible and inedible, from replacing the exotics. Such operations are only feasible on a small scale and the expense is likely to be greater than the value of the fodder produced, and, as indicated, they are no real solution of the problem of improving the grazing in very extensive areas.

Attention is also drawn to two articles in INDIAN FARMING, viz. 'New Plants for Old Pastures' by W. Burns (Vol. I, No. 1, Jan. 1940), and 'More New Plants for Old Pastures' by R. C. Woodford (Vol. I, No. 6, June 1940). These articles deal with certain exotic clovers now under trial.

What's doing in All-India

THE UNITED PROVINCES

By S. D. Joshi, B.Sc. (Agri.) (Lond.)
Deputy Director of Agriculture, United Provinces, Lucknow

THE work of agricultural improvement and village uplift continues unabated. In the absence of reliable seed merchants the Agricultural Department has to undertake the work of distributing improved seed throughout the province, the quantity running into lakhs of maunds every year. Arrangements were made as usual for the supply of improved seeds of *kharif* crops to the cultivators, on cash, cash-credit and *sawai*. The last-mentioned system is the most popular and is most widely used. It consists of giving out seed at sowing time and in realizing one and a quarter times the quantity at harvest.

The staff of the Agricultural Department was also engaged in explaining the advantages of sowing improved varieties of seeds and in demonstrating the sowing of *kharif* crops in lines, and in other general propaganda. Agricultural implements like soil-turning ploughs, bullock-drawn hoes and harrows, chaff-cutters and cane crushers were given out to the cultivators.

Better-living societies continued to be organized in the villages, 587 such societies being organized during the quarter. The number of registered societies increased by 295 to 5,146. Better-living unions were formed in 42 development centres. In addition to these 91 cooperative societies were organized for miscellaneous objects such as sale, supply, credit, consolidation of holdings, etc.

Criminal tribes make good

A scheme of cooperative farming by members of the criminal tribes, in the Aryanagar settlement, which is about seven miles from Lucknow, was prepared and launched in June 1939. Sixty-five settlers were selected for farming 200 acres of uncultivated land on a cooperative basis. The manager of the settlement was made a *sarpanch* of the society. The Department of Agriculture appointed one inspector, one supervisor and three *kamdars* to assist the society in farming the land for a period of two years, and work was started with ten pairs of bullocks. The land being in a very poor condition and impregnated at places with injurious salts, it was expected that there would be a loss of about Rs. 1,000 in the first year; but in the very first year the value of the crops grown on this land exceeded the expenditure incurred in production by Rs 1,613. The encouraging results obtained so far augur well for the future of the cooperative farming society.

Schemes for the development of means of irrigation in the eastern districts were pursued in right earnest and 356 new irrigation wells were completed and 628 old wells were bored and repaired. For storing irrigation water 638 embankments were also constructed. In order to increase their manure supply and preserve cattle urine for manurial purposes, 11,808 manure pits and 6,489 urine preservation beds were made by the farmers.

Livestock improvement

Improvement in the quality of livestock was a marked feature of the activities during this quarter. In all 690 improved breeding bulls were purchased by the cultivators for cross-breeding as against 310 of the preceding six months. The number of improved breed cattle purchased was 3,372 as against 1,693 purchased in the previous quarter. There were 3,870 scrub bulls castrated and veterinary treatment was given to 19,637 animals.

In order to conserve and increase the fuel resources of the cultivator, who burns cowdung on account of the scarcity of wood fuel, propaganda was started for more fuel plantations and over 1,000 acres were set apart by the villagers for fuel plantation at the commencement of the rains.

The necessity of including fruit in their diet was stressed and the villagers were encouraged to plant fruit trees on their lands. The new tenancy laws of these provinces have afforded the cultivators a very good opportunity of planting fruit trees on their land for home consumption. Well-to-do cultivators were encouraged to reserve 100 acres of land for fruit plantations.

Medical relief continued to be provided in the villages by the 244 fixed and 16 travelling rural development dispensaries. About 4,000 medicine chests are maintained by the Rural Development Department and are in the custody of responsible literate villagers. In the villages under the rural development scheme the fixed and travelling rural dispensaries, together with the medicine chests, combined to treat 228,308 patients free of charge. Anti-epidemic inoculations and vaccinations were carried out in 25,715 cases and 1,610 villagers were trained in first-aid in order to help and succour the people in case of accidents.

Physical culture clubs

Improvement of village sanitation and physical culture amenities was attempted as usual. About 490 *akharas* (physical culture clubs) were started, 5,901 villages were thoroughly cleaned, 1,446 drinking water wells were parapetted, 495 bathing enclosures and 376 bore-hole latrines were constructed. Tournaments were held in 493 rural development centres where sports and games helped to create an interest in physical culture and a healthy mode of living.

Steps were taken to make the villagers better informed and educated. Arrangements were made to give brief training in the principles and methods of adult education to the teachers employed in adult schools. Nearly 300 rural development libraries and reading rooms continued to provide interesting and useful literature to the village population. Over 60 radio receivers installed by the Rural Development Department and about 18 sets arranged through private effort continued to broadcast the rural programme of the Lucknow Radio Station in the villages situated within a hundred miles of Lucknow. Three rural development vans carried on propaganda in the different districts of the province, broadcasting radio programmes, playing instructive gramophone records and giving magic lantern shows, accompanied by instructive talks by the officials in charge of the vans. One of the common features in the country is the frequency of cattle fairs where thousands of people assemble for the purchase and sale of cattle.

Interest of villagers

The interest taken by the villagers on such occasions signifies the importance they attach to cattle as an economic asset to their profession of agriculture. With a view to directing the interest of the villagers towards cattle improvements, the Civil Veterinary Department held cattle shows in the districts of Aligarh, Bulandshahr, Meerut and Muzaffarnagar. Twenty cattle shows were held last year and a sum of Rs. 2,100 was distributed in prizes for good cows and their progeny by Government bulls. At these shows lectures were given on the methods of improving cattle, and their care and management. Methods for the control of contagious diseases were also explained. Leaflets on the various aspects of animal husbandry practices were distributed, and at some places, practical demonstrations of castration by the Burdizzo castrator were given. The shows have been successful both from the point of view of entries and the interest taken by large numbers of visitors. The shows provided an opportunity of viewing at convenient centres in local tehsils, the progress made by selective breeding. The progeny of scrub bulls was exhibited as a contrast to that of approved stud bulls and this further provided a good opportunity to the villagers to exercise a keen eye for quality. The shows also attracted buyers of livestock from the adjoining districts.

THE PUNJAB

By Malik Amanat Khan, B.Sc. (Edin.), P.A.S. (Class I)
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SUMMER rains this year were timely and well distributed. These rains were very much appreciated, particularly in the *barani* areas where they not only proved beneficial to the standing *kharif* crops but ensured *rabi* sowings also.

As readers of Indian Farming are already aware, a severe famine has been raging during the past three years in parts of the Ambala division where, in order to remove the scarcity of food and fodder, the Punjab Government has spent colossal sums of money. The tract which suffered the most from famine was the famous Hariana tract, well known throughout India for its splendid breed of cattle bearing the same name. At one time the extinction of this fine breed was imminent, but the generosity of the Punjab Government saved it, thus earning the gratitude of all admirers of these animals.

Another feature during the close of the quarter was the damage caused by the hailstorm to the crops in a number of villages in various districts of the province. Of all the calamities none is more severe for a cultivator than the total destruction of his crops by climatic inclemencies such as hailstorms.

Crop pests and diseases are comparatively lesser evils for even in very severe outbreaks there are always some prospects of saving a portion of the crop, but such possibilities are extremely rare in the case of a hailstorm. Fortunately the damage caused is generally localized and that too in a definite direction.

Crop prospects

The weather has been generally favourable throughout the province and the condition of cotton and sugarcane crops is promising. So far the first picking of *desi* cotton has already been taken and the prospects of a good harvest are bright. American cotton, however, has still to pass through critical days. Although its vegetative growth is very good, the opening of bolls has not yet started and it is yet to be seen whether the opening will be normal or defective.

The departmental drive for sowing of cotton in lines has borne good results and large areas are now seen sown in lines.

An important item of work of the Agricultural Department during the quarter has been the purchase of wheat and berseem seeds for supply in the forthcoming *rabi* season. Large quantities of the seed of C 591, C 518, and 8-A wheats have been purchased and stored in the various seed agencies in all the agricultural circles. C 591 wheat is the most popular variety for average as well as for fairly good soils, while C 518 is in demand for good soils only. 8-A is now being gradually ousted and replaced by C 591, but its demand continues on comparatively inferior lands.

Toria was sown towards the end of the quarter. Large quantities of seed of Selection A, a variety which has recently been given out by the Oilseeds Botanist and is now recommended by the Department, have been distributed to the zemindars in the canal-irrigated tracts of the province.

Irrigation experiments on wheat

The most important and fundamental principle of irrigation farming is the economical use of irrigation water; yet very few farmers appreciate the enormous waste which is taking place through lavish application. In the canal colonies the fields are seldom divided into *kiaris* (seed-beds) and the water is generally let into them from one end to irrigate an area of from two to five acres at a stretch. Very few cultivators seem to realize the fact that it is not the total quantity of water applied to a crop which gives the highest yield but its judicious use. There is a limit beyond which no additional watering brings any increase in yield.

In the canal-irrigated tracts in the Punjab, generally three irrigations after sowing are applied to the wheat crop. Any reduction in that number would enable the farmers to

put a larger area under the crop with the same amount of water.

Experiments were therefore started in 1931-32 at Lyallpur to compare one, two and three irrigations after sowing. The sowing of wheat in all these tests was done in the first week of November and the varieties under trial were 8-A, C 518 and C 591—all improved and popular wheats.

As a result of these experiments the following broad conclusions can be drawn:

(1) With good preparatory cultivation (during fallow) and in the absence of weeds two irrigations after sowing seem to be the optimum number for the wheat crop under canal-irrigated conditions.

(2) More than two irrigations after sowing encourage vegetative growth, which causes lodging in the crop, resulting in a lower grain yield.

Varietal trials on citrus fruits

Some of the most important citrus fruits grown in the Punjab are Malta orange, *sangtra* orange, grape-fruit, lemons and limes. Since the appointment of the Fruit Specialist and his staff, considerable experimental work on these fruits has been carried out. About 40 varieties of Malta oranges, both indigenous and foreign, have been under trial for some time now. Several strains of the blood-red variety, mostly the progeny of trees of outstanding merit in the Punjab, are also under trial. As a result of these tests, the following varieties have been selected both for yield and quality and are now being propagated for supply to fruit growers—Venille, Musambi, Jaffa, Dulcis, Seville, Callibrain Red, Ruby and Gujranwala Blood Red.

Similarly, in the case of the *sangtra* orange, about 32 varieties are under trial, including eight obtained from the U. S. A. and six from Nagpur and the remaining from various parts of India and South Africa. Of these, the Natal tight-skinned naartjee, Nagpuri, Coorg and Lahore (selected strain) are promising.

Grape-fruit juice is gaining popularity amongst the upper middle classes of the Punjab. In order to meet the local demand, about 14 selected varieties have been obtained from places such as Calcutta, Poona, South Africa, Florida and California. Observations made on them so far have shown the following to be suitable both in yield and quality—March Seedless, Duncan, Foster (pink) and Poona budded.

The importance of lemons and sweet-limes for their valuable anti-malarial and other properties is now well established. A number of varieties of lemons from various places in India and abroad are under trial. Of the foreign types, Eureka, European and Villa France have proved suitable. A seedless variety obtained from Nagpur bears almost throughout the year. At the Sargodha Farm, in addition to the European varieties mentioned above, Lisbon, Hill Allahabad and Hill Lucknow have proved heavy bearers. Among sweet-limes, Lahore (selected strain) is the best, followed by Amritsar, Gujranwala and Bangalore varieties.

Poultry

No further reports of Ranikhet disease have been received. The effect of its ravages is, however, being felt in the shortage of stock and eggs in the areas affected. Eggs are selling at 6 as. a dozen in rural markets compared with 3 to 4 as., the usual rate at this time of the year. Reports regarding the rearing season are, however, favourable.

The Punjab Cooperative Department is anxious that its staff of inspectors and sub-inspectors are fully acquainted with the needs of the rural poultry industry. The staff have recently undergone a course of lectures and demonstrations at the Experimental Poultry Station, Gurdaspur.

A number of agriculture teachers employed in rural schools in the Gurdaspur district were also given a short course of training in poultry-keeping with the object of introducing improved methods. Schemes for starting small poultry farms at their respective schools are under consideration.

Horse-breeding activities

The healthy and invigorating climate of the Punjab not only produces a robust, vigorous and virile population, but some of the breeds of horses found in the Punjab surpass other

Indian breeds in graceful build, stamina and swiftness. The Punjab is proud not only of her soldier sons whose valour and dauntless courage is known throughout the Empire's far-flung battlefields, but also of the fine chargers of Indian cavalry and the massive mules which continue to haul heavy artillery in mud and slush where mechanical transport is useless.

The fine qualities of our horses and mules were fully appreciated by the army authorities who through the Army Remount Department have been encouraging horse- and mule-breeding in certain parts of the province. One form of encouragement was the grant of land in the horse-breeding tracts in the province when the Government of India sanctioned the colonization of the tract between the Jhelum and Chenab Rivers.

With these grants two irksome conditions were imposed. Two squares of land (about 50 acres) were given on the condition that the grantee should maintain a mare fit for breeding horses for the army and giving the army the option of purchasing young stock. In addition, to keep the grant intact and avoid sub-division and fragmentation of land by inheritance to such an extent that the maintenance of a mare became impossible, the principle of primogeniture was introduced.

Since 1921, the Punjab Government had been pressing the Government of India to abolish these conditions and it is a matter of gratification that the plea has now been accepted.

These grantees will acquire proprietary rights at the extremely cheap rate of Rs. 40 per acre if payment is made in a lump sum or in two instalments, while for those whose financial condition is not so sound the Government have provided for payment in as many as 80 instalments.

Sir Sunder Singh Majithia, Revenue Minister in the Punjab Government, when making this important announcement recently at Sargodha, paid a well-deserved tribute to the officers of the Army Remount Department and the horse-breeders of that tract in the following terms:

Aided by the skill and patience of successive officers of the Army Remount Department, the horse-breeders of Shahpur have been carrying on the traditions of a horse-loving race and have attained a standard which has obtained recognition in distant parts of India. He appealed to the breeders not to relax their efforts and hoped that the keenness and skill which have won distinction in the past will continue to guide them in future.

He also pointed out that in a country like India where means of communication are poor horses are still needed and cannot be replaced by motor.

Rural development

Your correspondent, who was working as Deputy Director of Agriculture, Lyallpur, for a brief period during the summer months, attended quarterly meetings of the Lyallpur-Sheikhupura District Officers' boards.

The importance of the work which these organizations are doing can be gauged by a large number of rural problems which are being successfully tackled by them. There is hardly any rural activity which is not receiving the attention of these boards, and during the brief period of their existence some of them have made a real contribution to the welfare of the rural population.

The work accomplished in the Sheikhupura district during the quarter can be taken as an example.

Briefly stated, the Education Department in this district is not only carrying on a vigorous campaign against illiteracy, but practical arts like those of *khes*-making, towel and *khaddar*-making, and *nawar*-making are being taught in selected schools to boys from the third standard upwards. In one of these schools the Japanese *khaddis*, which weave superior shirting cloth of mercerized silk, have been introduced.

The staff of the Public Health Department carried out the following useful items of work during the quarter.

Manure pits dug	577
Old pits reconditioned	732
Ventilators fitted	1,811
Pucca drains constructed	4,684
Mosquito breeding places filled in	506
New wells constructed	3
Old wells repaired	55
Construction or repairs of parapets	41
Hand-pumps installed	399
Village ponds improved	1

Castrations and inoculations against contagious diseases were 1,797 and 16,350 animals respectively during the quarter. Village panchayats decided 129 civil cases, 77 criminal cases and 16 compulsory education cases.

The Cooperative Department registered 2 thrift and credit societies, 2 cattle-breeding societies, 3 societies for consolidation of holdings, 4 *dehat sudhar* societies and one public health and medical-aid society. The total area consolidated during the quarter was 3,254 acres and Rs. 331 were recovered as contributions. In Sheikhupura tehsil, the recovery agent stationed at Marh Balochan has collected produce worth Rs. 1,647 to help recoveries from societies not financially well off. Nine dramatic shows were given by the Cooperative Dramatic Party in the district.

Dehat sudhar *training camp*

A *dehat sudhar* training camp was held at Martinpur for six weeks in August and September. Twenty-seven young men were admitted. They were given training in the improved methods of agriculture, in grafting fruit trees, in cattle-breeding, in hygiene and sanitation and in cottage industries such as soap and toy-making.

A similar camp for ladies was also held in Martinpur during the same period. The number of campers ranged between 40 and 60. The programme of the camp included training in subjects such as domestic hygiene, first-aid, food value and menu-drafting, cottage industries, girl-guiding and housewife's daily routine. A baby show was held and prizes awarded.

The Department of Agriculture sold improved seeds of berseem, *toria* and gram and made arrangements for stocking large quantities of wheat seed. Demonstration plots of rice, *chari* (fodder) and maize were also sown on zemindari land and a large number of agricultural implements such as chaff-cutters and hoes were sold.

SCENES FROM A BI-WEEKLY CATTLE *HAT*

By Pati Ram Kala, G.B.V.C., P.G. (Lahore)

Assistant Marketing Officer, Agra

ABOUT a decade back, the bi-weekly cattle *hat* (market) of Agra used to be held at Sultanpur, Agra Cantonment. The trade is in the chain of markets for meat, mutton, hide, skin, *biltong* (Burma dry meat), *Upar*-wool (wool from slaughtered skins), who are the sole functionaries at the *hat,* found it convenient to shift it to Idgah, Agra. The open space just in front of the main gate and boundary wall of the Idgah, measuring about 500 yds. by 200 yds., was selected for holding bi-weekly *hats* every Monday and Friday. The land belongs to the Juma Masjid Trust and is leased out to the representatives of the trade on an annual payment of Rs. 150.

Income and expenditure

The trade, by mutual agreement of its panchayat, annually auctions the *hat* to the highest bidder of its own community for a sum ranging between Rs. 1,200 to 1,800. The contractor realizes market charges at the rate of one anna six pies per head of horned cattle and two annas per score of sheep and goats. The money thus realized is spent in paying Rs. 150 to the Juma Masjid Trust as rent of the land and in the management of an Anglo-Vernacular middle school that has been organized to impart education to the boys belonging to the community.

The *hat* serves exclusively the local slaughter-houses. About 30 butchers attend the *hat* and handle about 300 head of cattle and 700 head of sheep and goats daily on each market day. The supplies are at the maximum from October to January, medium from February to May and minimum from June to September, according to the demand for *biltong*, hides, skins and wool.

Cattle are brought to the *hat* from the villages of Agra district only. The horned cattle of the adjoining states of Bharatpur, Dholpur, and Gwalior are prohibited under

State laws from coming to this province, except during the state cattle fairs that are held once a year for a fortnight to one month during the *dasehra* festival. Sheep and goats are brought to the *hat* from nearly all the Rajputana states as far as Jaipur, Jodhpur and Bikaner.

No market information

The chief means of communication are roads, cattle- sheep- goat-tracks, there being complete absence of rail- and water-borne traffic. Both assembling and distributive traders do not make use of the telegraph or telephone. There is complete absence of market intelligence both at assembling and distributive centres. Assemblers bring to the *hat* the herds of cattle and flocks of sheep and goats by walking stage by stage by different roads and tracks. When they reach the octroi posts of the Municipal Board, they are charged octroi at the rate of six annas and one anna six pies per head of cattle and of sheep and goats respectively.

The income derived from octroi charges belongs to the Municipal Board and has nothing to do with the *hat* which is an organization of the trade dealing in slaughter cattle, sheep and goats. There are no regulations sanctioned by law to control its activities. The butchers' panchayat, which has taken the *hat* land on lease from the Juma Masjid Trust, is the sole regulator of the *hat* and manages its affairs independently of the Revenue, Police, Municipal and District Board authorities.

Hours of business

The *hat* does not provide facilities for the assembling trade. Like other *hats* of the province it is held in an open place lying between the wall of the Idgah and the Cantonment road. Assembling merchants reach the *hat* between 5 a.m. and 10 a.m. They keep their respective herds and flocks at different places within the boundary of the *hat*. The distributive merchants who belong to Agra city visit the *hat* at about 6 a.m. and finish their purchases by 12 noon. The unit of sale in the case of cattle is one animal and in the case of sheep and goats is one score.

A VISIT TO THE MADHURIKUND FARM

By R. L. Kaura, B.V.Sc., M.R.C.V.S.

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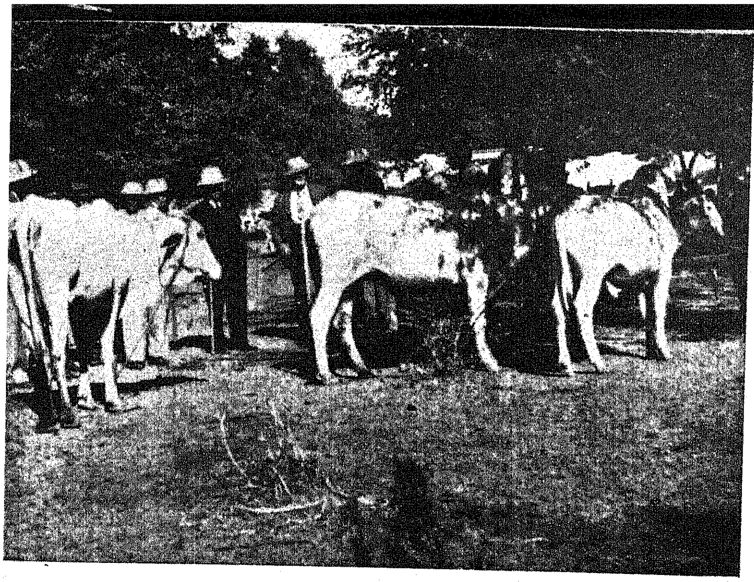
MEMBERS of the Animal Husbandry Wing which met at Izatnagar in November had an opportunity of visiting the Madhurikund Cattle-breeding Farm of the United Provinces Department of Agriculture. The Farm, which derives its name from the village of that name, is situated on the lower Jumna Canal about 14 miles from Muttra on the Muttra-Drig Road and is easy of access by rail and bus. A party left Izatnagar on the night of the 20 November 1940 and arrived next morning at Muttra Junction where they were received by Mr G. N. Vyas, the Divisional Superintendent of Agriculture. After breakfast, the party left in two buses for the Farm.

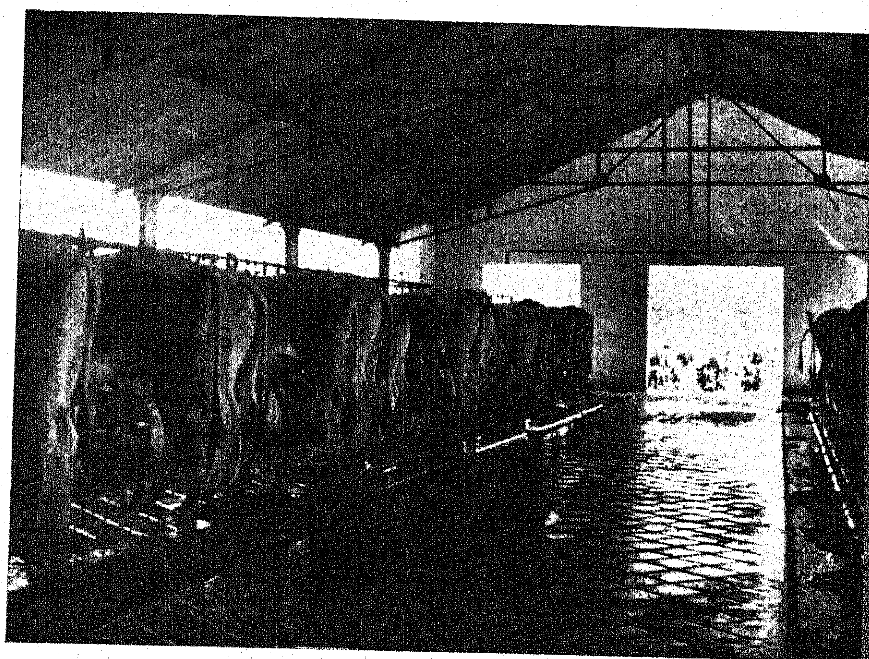
On the way to the Farm were village cattle and buffaloes specially collected on the canal bank to demonstrate the marked all-round superiority of the progeny of the pedigreed bulls issued by the Farm to the progeny of the ordinary nondescript village bulls (Plate 25). It was an impressive show.

Extensive operations

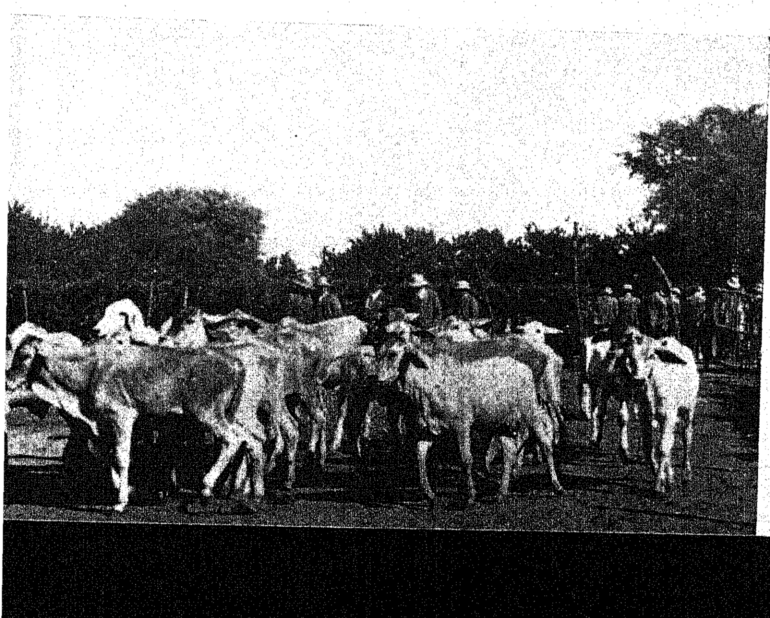
The Farm was first started by the Civil Veterinary Department, U. P., in 1914 as a cattle-breeding centre, but in 1921 it was transferred to the Department of Agriculture. It is now a mixed agricultural and cattle-breeding farm and covers an area of 1,396 acres of which 450 acres are under cultivation and the rest is pasture and jungle. There are 815 cattle and buffaloes on the Farm the details of which are given in Table I.



Left : A village cow and her progeny sired by a pedigree bull issued by the farm



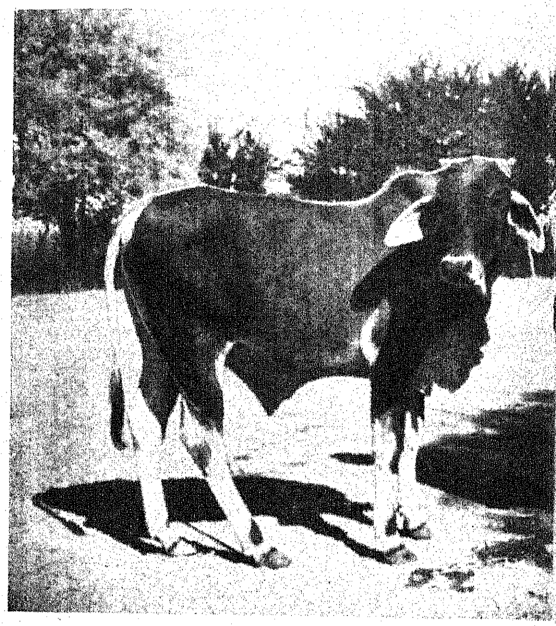
ıt : The main cattle shed

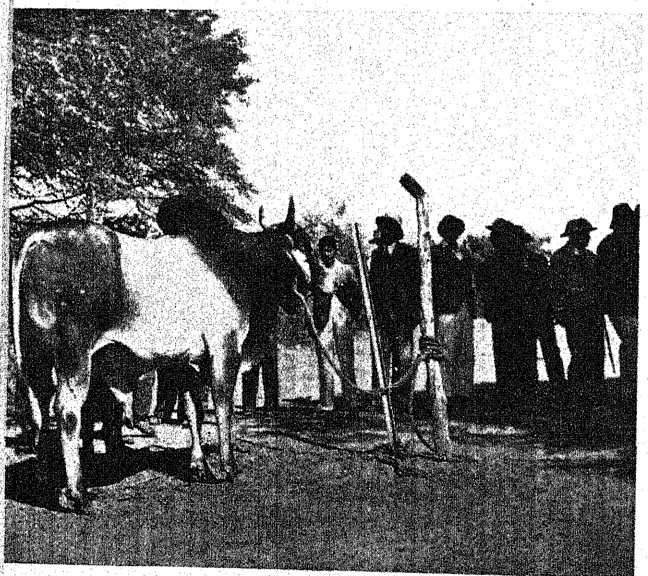


Left : Weaned calves

Left : A calf showing the deformity of the ho
fore-limb

Right : A one year old calf





Left : A Hissar bull bred at the farm

Right : Murrah buffaloes

TABLE I

Cattle at the Madhurikund Cattle-breeding Farm

Breeds	Cows above 4 years	Cows and heifers below 4 years	Bull calves	Stud bulls	Suckling and other calves	Withdrawn bulls	Working bullocks	TOTAL	REMARKS
Hissar	107	164	44	9	153	6	45	528	
Murrah	61	45	20	4	100	1	15	246	
Ponwar and Kherigarh	6	1	4	..	4	..	..	15	For show purposes only.
Sahiwal	..	..	24	..	..	..	..	24	Kept temporarily for distribution.
Mules	..	..	..	..	..	..	..	2	
TOTAL .	..	..	..	..	..	..	..	815	

A senior member of the Subordinate Agricultural Service is in charge of the Farm, and a qualified Veterinary Assistant Surgeon who had his postgraduate training at the Imperial Veterinary Research Institute is responsible for maintaining the animals in health. The primary objects of the Farm are:

(i) Raising pedigreed Hissar and Murrah bulls for distribution to zemindars, *gowshalas* and breeding societies for grading up local cattle. The bulls are given on loan for the period they remain active after which they are withdrawn, castrated and sold as bullocks for work.

(ii) The improvement of these breeds at the Farm by careful selection and line-breeding.

The area under cultivation provides all the fodder needed as well as some grains. Average yields of green fodder are as follows:

Jowar	280 md. per acre
Maize	300 md. ,,
Berseem	450 md. ,,
Lucerne	400 md. ,,
Oats	500 md. ,,

In some fields berseem yielded over 1,000 md. per acre in five cuttings. On an average 120,000 md. of fodder are raised on the Farm and a third of this is converted into silage.

An interesting deformity

The party first went to the main cattle-shed which is built on hygienic principles for cows in milk (Plate 25). There were 107 Hissar cows which were in very good condition and their milk yield was as follows:

Above 4,000 lb.	3
Between 3,000—4,000 lb.	20
Between 2,000—3,000 lb.	44
Cows in first lacation	15
Below 2,000 lb.	25
TOTAL .	107

The party then moved towards the calf pens where calves were accommodated separately according to age. The calves were in good condition (Plates 25 & 26). An interesting case of deformity of the hoofs was observed in a calf (Plate 26). In either of the fore limbs, there was only one digit instead of two, with no trace of an inter-digital space. It was said that the sire of that calf has previously produced two other calves with the same defect but other progeny of this sire and of the dams of these calves were quite normal.

Next the visitors were shown the stud Hissar bulls which were good specimens of the breed (Plate 26). The scales of ration in vogue for the various kinds of livestock at the Farm are given in Table II.

Green fodder is given *ad lib.* and consists of silage and berseem, oats, maize, *jowar*, etc. according to the season of the year.

Then the party was shown the Murrah buffaloes and a small number of Ponwar and Kherigarh cattle (Plate 26). There were 61 buffaloes in milk. They were fair

TABLE II

Scales of Ration in use at the Madhurikund Cattle-breeding Farm

Animals	Parts constituting the concentrates mixture: Wheat bran	Groundnut cake	Mustard cake	Linseed cake	Barley	Gram	Mineral mixture	Average daily allowance per head in lb.	Remarks
Young stock from birth to 1 month	..	..	..	..	..	..	..	..	Only 8 lb. whole milk allowed under the Dam.
1 month to 3 months	2½	..	..	4½	3	..	3 % of Concentrates mixture	1 lb.	In addition to 6 lb. whole milk allowed under Dam.
3 months to 6 months	2½	..	..	4½	3	..	3 % of Concentrates mixture	2 lb.	Ditto ditto.
6 months to 10 months	2½	..	..	4½	3	..	3 % of Concentrates mixture	2 lb.	In addition to 4 lb. whole milk allowed under Dam.
10 months to 12 months	2½	..	..	4½	3	..	3 % of Concentrates mixture	2 lb.	No milk allowed.
Hissar cows and Murrah buffaloes in milk	2	1	1	..	5	1	3 % of Concentrates mixture	4 lb. + ½ of milk yields received in pails.	Where there is sufficient grazing or green fodder is available in plenty, maintenance ration is reduced to 2 lb. per head.
Pregnant Hissar cows and Murrah buffaloes	2	1	1	..	5	1	3 % of Concentrates mixture	4 lb.	
Hissar and Murrah heifers	2	1	1	..	5	1	3 % of Concentrates mixture	2 lb.	No concentrates allowed during rains.
Hissar and Murrah bull calves	2	1	1	..	5	1	3 % of Concentrates mixture	2 lb.	Ditto ditto.
Stud bulls	2	1	1	..	5	1	3 % of Concentrates mixture	4 lb.	
Working bullocks	1	1	1½	..	5	1½	2 %	4 lb.	Reduced to 2 lb. when there is light or no work.

examples of the breed and their milk yield was as follows:

Above 5,000 lb.	5
Between 4,000—5,000 lb.	16
Between 3,000—4,000 lb.	22
Below 3,000 lb.	18
TOTAL	61

Regular milk records are maintained by the Farm staff and have been checked by the Milk Recorder provided by the Imperial Council of Agricultural Research. The total quantity of milk produced daily on the Farm is about 15 md. for the disposal of which a new flat rate of Rs. 4 per md. has been obtained from a contractor.

The party then saw some dry cows, buffalo bulls, a small number of Sahiwal bull calves and silo pits. *Kacha* pits were in use and in order to increase the palatability of the silage and to reduce wastage, molasses is mixed at the rate of 2 md. per 100 md. of fodder. The silage made in this way was reported to be sweeter and greatly relished by the animals.

Nutritional experiments

After lunch at the Farm Rest House, where a gay *shamiana* had been put up, the sheds where nutritional experiments under an I C A R scheme are in progress were visited. Under the scheme experiments have been conducted by Mr N. C. Das Gupta on the effect of 50 and 75 per cent replacement of concentrates by berseem both as green and as hay on the growth and milk yield of Hissar cattle and Murrah buffaloes, keeping suitable controls, in order to determine an economical method of feeding. It has been found that it is possible to replace 75 per cent of the concentrates with berseem without any appreciable difference in the growth and milk yield. The experiment is, however, going to be repeated this year. More recently comparison of the production value of protein grains and

oil-cakes had been taken up and linseed-cake, groundnut-cake, *arhar chuni* and gram are under investigation.

In the afternoon Mr T. H. Naqvi, Deputy Director of Agriculture, Bundelkhand Circle, was at home to the guests. The whole programme was a treat which the visitors greatly appreciated. On behalf of the visitors Mr Sam Higginbottom thanked the host for the tea and also for the successful arrangements which he, Mr G. N. Vyas and the Farm staff had so kindly made to make the trip interesting and educative.

The Farm also grows fruits and some of the visitors purchased grape-fruits and maltas to take home with them.

The excursion was a great success. It afforded an excellent opportunity for visitors to see how cattle-breeding was conducted under the auspices of the United Provinces Department of Agriculture, and the Farm staff no doubt benefited from their discussions with the expert visitors.

The accompanying photographs were taken by Mr B. K. Badami, Director, Civil Veterinary Department, H. E. H. the Nizam's Government. I am indebted to Mr T. H. Naqvi for details of the Farm.

THE CULTURE OF THE PAPAW*

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The papaya (*Carica papaya*, L.), or papaw as it is popularly called in South Africa, is indigenous to Tropical America, but its exact origin has not been determined. Related species grow wild in that country, and the papaw is believed to have originated from a cross between two of them. It is an important crop and is at present grown in practically all the sub-tropical and tropical countries of the world. As a health-food the papaw has few equals, and it should receive wider recognition in countries outside the tropics.

Description

The papaw is a large herbaceous plant (5) with a hollow and fibrous trunk. The leaves are usually seven-lobed, two or more feet across, and are borne on long leafstalks, so that the general appearance of the tree is somewhat palm-like.

The groves in South Africa are mostly composed of diœcious varieties (male and female flowers borne on separate plants) with a small percentage of monœcious types (male and female flowers borne on the same plant) intermixed. With the exception of fruit and flower characteristics, these sex forms are identical in general appearance. The ordinary male and female plants are representative of the diœcious types.

Female (see Fig. 1).—The flowers are borne on short stalks, 1 to 3 in. in length, in the axils of the leaves, and are characterized by the absence of stamens. The fruit may be oval, pear-shaped or practically round.

Male (see Fig. 2).—The typical male or staminate tree produces its flowers in clusters on long pendulous flowering branches. Each flower usually has ten stamens and an abortive pistil. Under certain climatic conditions the pistil may on occasions develop normally and the male tree may bear a few fruits, which are usually cucumber-shaped.

Hermaphrodite (see Fig. 3).—The ordinary hermaphrodite tree is typical of the monœcious types, which may produce various combinations of male, female, and perfect flowers. (Perfect flowers are characterized by a well-developed pistil and stamens). Cucumber-shaped fruits are usually produced; but round, pear-shaped, or irregular fruits may occur in the same cluster with the first type.

The marked variation in the shape of the fruits on the same tree, and the low yield, are the chief objections against the growing of hermaphrodite trees on a commercial scale. The fruit of the female is fairly uniform and differs usually only in size, which characteristic, coupled with a good yield, makes the female the most desirable type to grow. It is dependent on the male, however, for the pollination of its flowers. Such pollination is essential for the subsequent normal set and development of the fruit of the female tree. Since the fruit produced by the male may be regarded as inferior, the only necessary function of the male is to produce pollen for pollination purposes.

Climatic requirements

The papaw is a heat-loving plant and is very susceptible to frost. In South Africa it thrives best in a sub-tropical climate as exists mainly in the eastern Transvaal lowveld and Natal, but is also grown in certain frost-free areas of the eastern Cape Province. Though atmospheric heat is conducive to fruit development and quality sunburn does much damage to fruit that is exposed as a result of leaf reduction through frost, wind or other adverse conditions.

Strong winds carrying sand and grit may injure the tender skins of immature fruits,

* Reproduced from *Farming in South Africa*, Vol. XIV, No. 161, August 1939.

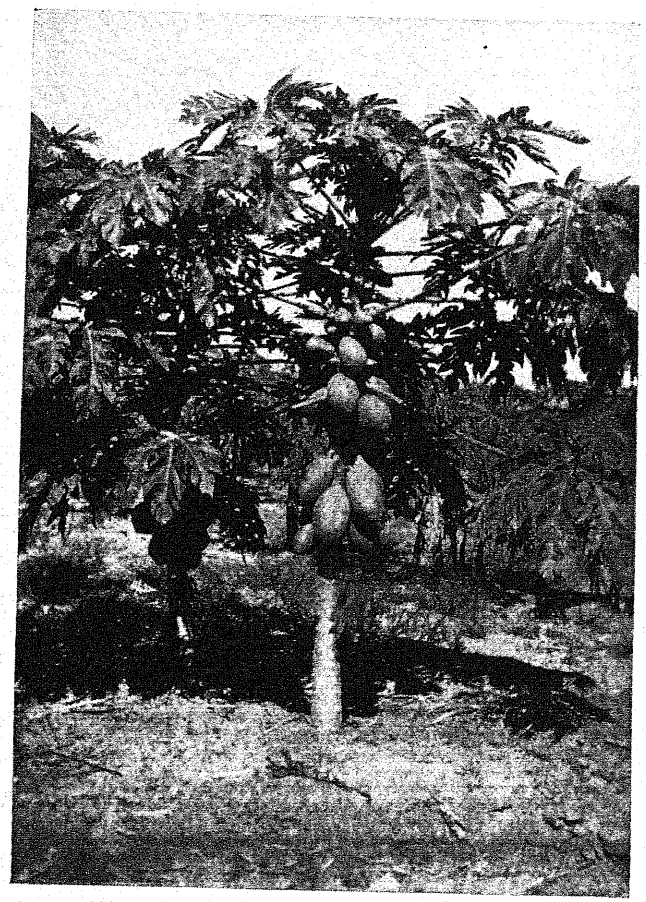

Fig. 1. A typical female tree

Fig. II. A typical male or staminate tree. Note the long pendulous branches.

FIG. 3. Hermaphrodite trees. Note the cucumber-shaped fruit

causing the white milky juice (papain) to ooze through the injuries. Such damage renders the fruit unsightly and impairs its keeping qualities. It becomes necessary, therefore, to consider such factors as natural and artificial protection (windbreaks) against wind and frost when a site for planting papaws on a commercial scale is selected.

Under climatic conditions of high relative humidity and comparatively high atmospheric temperatures, papaws thrive but the fruits may not colour up sufficiently when reaching maturity and may remain pale green. Notwithstanding the excellent eating-quality of the ripe fruit, the lack of colour will affect the market price adversely. Experiments have shown, however, that colour may be improved by selection (2).

Seed and selection

Since the papaw is cross-pollinated, the progeny is usually very variable, and therefore it is of the utmost importance for the grower to obtain his seed from a reliable source where selection has been in operation for a number of years. If such seed is not available, the grower must select seed only from the best trees, attention being paid to the following points: vigour of trees; size and shape of fruit; colour of ripe fruit; thickness of flesh; quality yield; optimum spacing of the fruit on the stem so that the shape of the fruit is not affected by overcrowding (1). The crop produced as the result of the first selection will necessarily be variable, but if the grower persists with this selection programme he will be rewarded by an increasingly greater uniformity of the crop after each successive generation. This procedure has already been practised by some growers with considerable success (2).

It should be mentioned here that the senior author has already made considerable progress in the breeding of desirable and true-breeding papaw varieties. Small quantities of seeds of these strains will probably be available for distribution to farmers after another two to three years of experimentation.

Sowing of the seed

Seedlings may be raised either in beds, in

until the top of the can is level with the soil surface. The plant, together with the tin, is now lifted—there being no danger of disturbing the soil around the roots—and is then taken to the field. Here the tin is put in the required place and the plant together with the soil, is removed by exerting pressure on the soil in the tin. For an effective operation of this method it is necessary to have the plants well-spaced in the bed.

Seed-trays.—Since papaw seedlings are especially susceptible to damping-off shortly after germination, the sowing of seed in trays is practicable only where this disease is not troublesome. It should be mentioned here that experiments have shown that conditions in trays are more favourable for the development of damping-off fungi than in beds. Where seedlings can be raised successfully in trays they may be transplanted at any earlier stage than those raised in beds. The result is a low mortality of transplants even under comparatively unfavourable conditions.

Seed-beds and seed-trays.—A method combining the advantages of the growing of seedlings both in beds and in trays eliminates most of the objections against either practice. Sow the seeds in beds in the usual manner, and transplant the seedlings to trays when they are about three inches in height. Most of the leaves should be removed on the previous day and the beds well-watered to facilitate the lifting of the plants. A tray, the size of a halved paraffin tin, has sufficient room for 30 seedlings. Water well and shade the trays for about ten days until the seedlings have become established. They are then gradually exposed to the sun and the amount of watering is reduced for approximately ten days prior to transplanting. The seedlings are ready to be transplanted three weeks after they have been set in the trays. We have found that very few plants are lost when this method is employed.

Strong tins may be cheaply constructed from sheets of galvanized iron.

Initial preparation of soil

Though the papaw will grow fairly well on soils of low fertility, growers are warned against the tendency to produce this crop under such conditions. For the best results, a soil rich in plantfoods is necessary, and if the soil is deficient in any plantfood constituent, suitable fertilizers should be added.

The soil should be well prepared by ploughing and discing to obtain the required friable condition. To facilitate irrigation, the layout should be such that the rows will be on the contour allowing a regular slope to 1 to 2 per cent. The planting holes, approximately 2 ft. in diameter and 2 ft. deep, should be spaced 10 ft. on the square. About 1 to 2 months prior to planting, apply one bucket of well-rotted kraalmanure and $\frac{1}{4}$ lb. superphosphate to each hole, and mix well with the soil.

Transplanting and thinning

Since, on the average, about 50 per cent of the seedlings are males, that is unproductive trees, it is necessary to plant 3 to 4 seedlings, one foot apart, in each planting hole. Transplant only on cool and cloudy days or preferably in rainy weather. The planting holes should be watered shortly before and immediately after the setting out of the plants. If possible the transplanted seedlings should be protected against the sun by means of grass shelters, until they have become established.

As soon as the plants start to flower they are thinned out to one, and occasionally to two, per planting hole, in such a manner that there will be approximately one male to every 20 females in the final stand. This ratio of males to females is necessary to provide adequate pollination for normal fruit development. Under favourable conditions ripe fruit may be picked off a tree one year from the time of the sowing of the seed.

Care of established plants

Established papaw plants are comparatively drought-resistant. However, to ensure high yields and sound fruit, and to protect the fruits against sun-scald, good leafgrowth should be encouraged by judicious irrigation. Some growers believe that the quality of the fruit is impaired by irrigation during the winter months. This notion is, however, not supported by the results of our experiments and is apparently not well-founded, when factors of low yield and sun-scald, as result of reduced foliage due to lack of soil moisture, are taken

into consideration. The frequency of irrigation during the dry period will depend on soil, climate and the size of the trees. In general, an irrigation every 2 to 3 weeks will be sufficient.

In our experiments, basin-irrigation has given excellent results. The basins are constructed around the trees and enlarged as the plants grow bigger, so that the whole root-zone area can be irrigated thoroughly.

The fertilizer programme will depend on such factors as natural soil fertility, nature of previous fertilizer application, previous crops grown, and the condition of the plants. However, the following recommendations should serve as a general guide for fertilizer application.

As soon as the plants have become established, a light top-dressing of quickly-available nitrogenous fertilizer such as nitro-chalk, sodium nitrate or ammonium sulphate, should be given and its application repeated two months later. Under average conditions, an annual application of approximately 10 tons of kraalmanure and 700 to 800 lb. of superphosphate per morgen* should keep the soil fertility at the required level.

During the summer months, a cover-crop such as sunn-hemp can be grown between the rows. This will help to remove excessive soil moisture during the rainy season, will control weed-growth, and will maintain the organic matter and nitrogen content of the soil.

Root-cutting is harmful, and discing should therefore be resorted to instead of ploughing. Do not disc too deeply or too close to the trees when fertilizers or cover-crops are incorporated with the soil.

Harvesting, packing and marketing

The harvesting season usually starts in April and May, lasts until the end of December, with the peak during September and October. In cooler climates the initial ripening of the fruit may be delayed till spring, in which case the picking season may extend to January or February. Under favouable growing conditions brought about by factors such as judicious irrigation during the dry season (May to September), a high soil-fertility level, and other cultural practices, the plants may continue to flower and set fruit, and thus serve to prolong the marketing season, within limits. Yields may vary from 20 to over 150 fruits per tree, depending on climate and soil.

The stage at which papaws are to be picked will depend chiefly on the distance from the market and the season. Mid-winter fruit should be picked at a much later stage than spring or summer fruit, because of the marked effect temperature has on the speeding-up or retarding of the ripening process subsequent to picking. Fruits picked too early do not develop the required flavour, texture and colour, whereas fruit picked at too mature a stage will lack keeping quality. The best guide is to pick at the latest stage possible for the fruit to reach the consumer in a sound condition.

In order to reduce wastage, the fruit should be handled carefully during harvesting, transport and packing. The use of picking-gloves will minimize fruit injuries during picking, and will also protect the picker's hands against the milky juice of slightly immature fruits. Such juice, owing to its strong digestive action, may in the long run cause considerable discomfort. The picked fruit is placed in woodwool-lined lugboxes and carted to the pack-house to be graded and packed.

The number of fruits per standard papaw box measuring 18 in. by 12 in. by 6 in. varies from 4 to 7 (depending on size). Medium-sized fruit which allows the packing of 6 fruits per standard box is preferred. It is important that the fruits packed in the individual boxes should be at the same stage of maturity. Papaw boxes must be lined with woodwool, and the fruit packed firmly in woodwool with a thin layer of woodwool placed on top before the lid is put on. For sending to distant markets, it is preferable to wrap the individual fruits in ordinary large-sized fruit wrapping paper.

For marketing under the National Mark Scheme, the following regulations should be observed :

Papaws must be graded as follows :

1. (*a*) First Grade.—Papaws must be free

* 2·1 acres.

from blemishes, injuries and bruises. Fruits packed in the same box must be at the same stage of ripeness, uniform in size and of one variety only. Fruits must not be too green or too ripe, and the flesh must be firm.

(*b*) Fruit must not vary more than 5 per cent from the foregoing requirements in respect of condition and external appearance.

2. (*a*) Only new and clean boxes must be used.

(*b*) The boxes must be of the following external dimensions: length 18 in., width 12 in., depth optional.

3. (*a*) Papaws must be packed wrapped.

(*b*) Boxes must be packed to full capacity.

(*c*) Fruit showing signs of any disease must not be packed under the National Mark.

(*d*) The count must be clearly marked on the boxes. Further particulars in this connection may be obtained from the Bureau of Domestic Markets, P. O. Box 8045, Johannesburg.

Papain

The milky juice which exudes from green fruit when the skin is lanced contains the ferment papain, which is considered to be a very valuable ingredient in medicine as a remedy for certain digestive troubles.

In the light of the unpublished investigations of H. Van Elden of the Sub-tropical Horticultural Research Station, Nelspruit, and the experience of other workers, the procedure for the extraction and drying of papain may be briefly summarized as follows:

Contrary to the general conception that non-metallic knives should be used when lancing the fruit for the extraction of the milky juice, it was found by Van Elden and others that special steel knives may be used without discolouring the latex. A steel-bladed knife has the advantage that a clean light incision can be made rapidly, without getting any of the green chlorophyll in the exuding juice.

The latex containing the papain is best obtained from full-grown, or nearly full-grown, well-developed green fruit by making 2 to 4 longitudinal incisions not more than $\frac{1}{8}$ in. deep. This operation may be repeated every 3 to 7 days. It has been found that better yields are obtained if only a few incisions are made at a time, the tapping being done over a long period until the fruit is covered with incisions approximately 1 cm. apart. The flow is most abundant in the early morning. Very young fruits give a latex that is rather weak in digestive power, while ripe fruits give very little, if any, milky juice. In South Africa we have a more or less definite period, from February to August, for tapping.

Only non-metallic containers, such as glass or porcelain dishes, should be used to collect the latex, because the juice acts on the metal and becomes discoloured. Coagulation soon begins and the mass adhering to the surface of the fruit must be carefully scraped off. Considerable time and labour would be saved if a convenient and efficient vessel could be devised which could be quickly put in place to receive the juice, permitting the operator to proceed to the next tree in the meantime.

The juice must be dried promptly after it is collected or decomposition, which destroys the value of the product, will occur. Sun-drying is practised to some extent, but it is much more satisfactory to dry the latex in a properly ventilated oven operated at 50 to 55°C.

One form of the drier (5) is about 3 ft. broad, 3 ft. deep, and 6 ft. long. The sides and ends are made of brick, and openings are provided at both ends, one for the flue and the other to admit fuel. A foot from the top, which is open, a sheet of iron is placed, and upon this one or two inches of sand are laid to modify and distribute the heat arising from the fire beneath. The coagulated juice is spread upon brown linen stretched upon frames, which are made to fit the top of the drier. The temperature should not exceed 50 to 55°C., since great heat destroys the ferment. The dry and flaky material can be ground in a coffee-mill, preferably when the material is warm, and it should then be in the form of a light cream-coloured powder. This powder should be placed in bottles, which should be tightly sealed.

Little information is available as to yields. Amounts of papain extracted per plant vary considerably; 20 to 250 gm. per tree, or from 60 to 350 lb. of dried latex powder per

morgen may be produced. Coagulated latex produces 25 per cent of its weight of dried powder. The latex is harvested through three seasons. By the fourth season the fruit is so high on the trunk that the cost of collecting the juice becomes prohibitive.

The price of the crude product is in the neighbourhood of 10*s.* per lb. It is a debatable point whether the production of papain in South Africa will be a paying proposition. Factors which will decide this favourably are cheap labour and high yields. The lancing operation, though it does not affect the quality of the ripe fruit (3), renders such fruit unsightly and hence unmarketable.

Such fruit is valuable in processing (3) since quality only, and not outward appearance, is the chief consideration here. It is considered that the collection of papain may become a profitable side-line in this and other countries, provided that it can be produced in conjunction with the manufacture of other by-products such as canned fruit pulp, conserve, butter, chutney, jelly, etc.

Uses of the papaw

According to Livingstone (3), the leaves, stems, roots and fruits of the papaw can be put to fifty different uses of which only fifteen have so far been utilized. The fruit may be canned—as butter, chutney or jelly—be crushed for soda-fountain use, or used as ice-cream flavouring or for syrups. The ripe fruit is frequently used in fruit salads or cooked as a vegetable. Rind and seed are processed for sale as a pickle relish. It is said that tough meat may be rendered tender by cooking it with green papaw fruit, or wrapping it in crushed papaw leaves. The fruit contains vitamins A, B, C and D which are vital for health.

The following recipes are given by Pope (5):—

Papaw Cocktail.—Cut papaw in dice or balls and serve in glasses with cocktail sauce and chipped ice. Or serve in the same manner with orange, lemon or lime juice, and a little sugar.

Papaw Whip.—To 1½ cups of papaw pulp, add juice of 1 lemon, ½ cup sugar and beat into 2 stiffly-whipped whites of eggs.

Papaw Pickle.—Make syrup of 1 measure sugar and ½ measure vinegar. Add a few whole cloves and peppercorns and 2 measures of half-ripe papaw cut into small pieces. Boil until tender.

Orange and Papaw Butter.—To 1 measure papaw allow ½ measure oranges. Wash oranges well. Squeeze out seeds and juice. Put skins through a meat chopper and add to the juice, strained free from seeds. Add papaw pulp cut in small pieces (without rind) and boil all together; then add as much sugar as pulp. Boil again for 15 to 20 minutes.

Baked Papaw.—Cut papaw in halves lengthwise. Add a little sugar and orange, lime or lemon juice, or a little cinnamon in place of the juice. Bake 20 minutes and serve immediately on taking from the oven. This is a vegetable.

Green Papaw Preserve.—Cut the fruit into slices. Peel and prick well on all sides. Cut into required sizes, put into lime water (1 tablespoon lime to 12 cups of water) and leave overnight. Drain and place the fruit in a boiling syrup made of equal quantities of sugar and water. (Allow 1 lb. of sugar for every 1 lb. of fruit.) Boil until the fruit is transparent and the syrup of the right consistency.

Green Papaw (*Vegetable.*)—Papaw, as a vegetable, is not unlike vegetable marrow. The papaw must be very green, i.e. the flesh still quite white. Boil rapidly. When tender, strain, mash or leave in little cubes. Add butter and salt to taste.

Insect pests and diseases

Fortunately, the papaw has very few enemies. Insect pests are of minor importance and these will therefore not be mentioned here.

There are only two papaw-diseases that are of any consequence in South Africa, and these are described below.

Foot-rot disease.—The general symptoms of this disease are the following:

A marked reduction in growth vigour of mature plants, resulting in a yellowing of the leaves and, in extreme cases, complete defoliation. Examination of the base of the trunk will reveal that rotting of stem slightly above and below ground-level has started. According

to Wager (6) the disease, which is caused by a Pythium fungus, becomes evident when the plant is subjected to unfavourable growth conditions such as poor drainage and poor soil fertility. When these unfavourable factors are remedied the disease may be easily controlled.

The Pythium fungus is sometimes very troublesome in seed-beds where it may cause damping-off of the seedlings. To control damping-off, it is advisable to sow the seed in clean soil, if possible, water only in the early morning or late in the afternoon, and provide good ventilation.

Stem-rot (*Anthracnose*).—The Plant Pathologist at the Sub-tropical Horticultural Research Station, Nelspruit, states that this disease appears in three stages on the papaw, viz. on the fruit, causing a rot in black round spots from $\frac{1}{4}$ to 3 in. in diameter; on the petioles; and on the trunk. Infected petioles will remain attached to the tree after maturity, whereas healthy ones will fall off. The fungus may gain entry into the stem through such infected petioles. The rotting of the stem due to anthracnose differs from that caused by Pythium (described above) in that the infection in the case of the former is usually well above ground-level, whereas in the latter case it is at or just under ground-level.

Control measures

Remove and burn infected petioles; if the infection is bad the trunks may be sprayed with a 4-4-50 Bordeaux mixture; in severe cases the infected portion is cut away and painted with Bordeaux paste, which is made by mixing Bordeaux powder with raw linseed oil.

Any further information relating to the culture of the papaw may be obtained from the Chief Horticulturist, Box 994, Pretoria. Those who desire advice in connection with (1) diseases of the papaw, and (2) insect pests attacking papaws, should communicate with (1) the Principal Plant Pathologist, Box 994, Pretoria, and (2) the Chief Entomologist, Box 513, Pretoria, respectively.

Literature

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(5) Pope, W. T.—Papaya Culture in Hawaii. *Hawaii Agr. Exp. Sta. Bul.* **61**, 40 pp. 1930.

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New Books and Reviews

Tropical Citrus Culture

By C. C. S. Stephenson with an introduction by the Hon. D. S. Senanayake (Messrs Harrisons and Crossfield, Ltd., P. O. Box 69, Colombo. 1940, pp. 82, Rs. 3·5)

THE manual of Tropical Citrus Culture is the fruit of Mr Stephenson's practical experience in citriculture in the Uva Uplands, Ceylon. He presents in this little book, in a very simple manner, advice on the problems confronting the local cultivator. The chapter on contour terracing, drainage and irrigation will, however,i nterest equally growers in other parts of India, who have to deal with undulating landscape.

The chapters on disease and pest control are more exhaustive than others and cover nearly one-third of the book. The author has rightly laid more stress on this aspect of citriculture in view of Ceylon's peculiar climatic conditions that favour the breeding of most diseases and pests of citrus. In view of the extreme dearth of literature on the subject pertaining to Indian conditions, this little book of a practical and popular nature will be welcomed by all. [L. S.]

***

Proceedings of the Third Meeting of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry in India

(Manager of Publications, Civil Lines, Delhi. 1940, pp. 213, Rs. 3-10 or 5*s*. 9*d*.)

IN December 1939, the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry in India held its third meeting at New Delhi. It will be recalled that the Board of Agriculture and Animal Husbandry is a sort of annual Parliament of agricultural workers and administrators from the whole of India; that it is divided into two wings (Crops and Soils Wing and Animal Husbandry Wing); and that these meet in alternate years. The proceedings of the Third Meeting of the Crops and Soils Wing have just been published. It was opened by Sir Jagdish Prasad, then Hon'ble Member in charge of the Education, Health and Lands Department, whose speech dealing with the importance of research even in war-time received considerable notice in India, in England and in America. The following main subjects were discussed in the meetings which followed:

(1) Soil conservation.
(2) The problem of the physical basis of soil structure and its relation to tillage and manuring.
(3) Vernalization.
(4) A review of work on agricultural economics in India and consideration .of the application of results obtained from such investigations to future agricultural development.
(5) Plant virus diseases.
(6) Plant hormones and their application in horticulture and the planting industry.
(7) A critical examination of the comparatively low yields per acre obtained from the major crops of India in comparison with other countries where similar crops are cultivated with a view to determining whether a re-orientation of agricultural work in India is required.
(8) Control of insect pests.
(9) Recommendation of the Conference of Ministers on Agricultural Marketing, 1938, regarding the setting up of a Standing Committee for Crop Planning under the Imperial Council of Agricultural Research. Report of a Preliminary Sub-Committee.

The original papers on these and the discussions are given in full. The volume like its predecessors is a valuable compendium of up-to-date information and opinion on the

important subjects which it discusses and is a useful reference book to all interested in the progress of agriculture in India.

***

Punjab Agricultural College Magazine, Vol. VII, May-July 1940, Nos. 5-7, Insect pest number

By Khan A. Rahman, B.Sc. (Edin.), Ph.D. (Cantab.), F.R.E.S. (The Punjab Agricultural College Cooperative Supply Ltd., Lyallpur, pp. 98, Re. 1)

THE Editorial Committee of *the Punjab Agricultural College Magazine* are to be congratulated on the attractive Insect Pest Number in a combined issue for the months of May, June and July, 1940. It deals with most of the important insect pests of crops in the Punjab and gives full and up-to-date information not only on the life-history and habits and damage caused by each pest, but also various approved practical methods of dealing with them. The short notes on the identification of the insect pests —though intended evidently for students of entomology—are given, as also information on such natural enemies as are efficient in control.

The insect enemies of many important crops of the Punjab have been dealt with such as those of cotton, sugarcane, rice, grain, vegetables and fruit trees and also of stored grain. General pests like the hairy caterpillar, white-ants and the desert locust have also received attention. At the end, very useful material on insecticides and sprayers and the other appliances in treating attacks of insect pests add to the value of the publication. It will doubtless serve as a nucleus for a handbook of Punjab crop pests.

In the preface the author pays a very handsome and well-deserved tribute to the organizing powers and enthusiastic work of Khan Bahadur M. Afzal Hussain who was responsible in bringing the Punjab Entomological Section to its present pitch of high performance during a period of 18 years, and a long list of entomological publications issued from Lyallpur since 1939 (issued as a supplement) would show that the author himself has been in no way less enthusiastic in upholding the high traditions set up.

While the general get-up and illustrations given are excellent, one may perhaps regret the printing mistakes, most of which, however, have been corrected in a list of errata.

[Y. R. R.]

Rag Bag

Rural propaganda

MUCH improvement in Indian agriculture can be achieved by a large amount of well-arranged and vigorous propaganda work. The success of propaganda depends on the personality of the workers just as great teachers make a great college. For this we need trained workers who will really mix with our farmers. The work might be conducted on the following lines :

i. Results proved fully at the district or provincial farms or by the workers of the Imperial Council of Agricultural Research remain embodied in reports. In my opinion the results should be illustrated by trained workers with charts, and lantern slides and by holding meetings in villages or farmers' cities at least for the benefit of the illiterate farmers.

ii. Trained workers should go to plant the departmental improved seeds on a farm of one ryot at least in each village and should advise the farmers to do the needful till the crop is harvested. If there be any loss under the supervision of the trained workers the Government should pay for the loss to the farmer. But if there be no loss, rather profit and higher yield than the farmer usually gets, the farmers will take that as a lesson. They themselves will spread that news amongst their brother farmers. Our farmers are generally declared to be conservative, but they are not. They can grasp anything which they find is worth trying. Much depends on the way we adopt to convince them.

iii. We will ask our Government to hold farmers' excursions from each district during the season to the provincial agricultural experiment farms. The Government in co-operation with the railway companies will make arrangement for special trains for bringing the farmers and their families from every part of the province free. When the parties arrive, the Experimentalist of the farm or trained field worker will guide the visitors and explain all the experiments that are being made on the plots. He will remember that he is explaining to them the newer and better facts of agriculture. The farmers will hold discussions right on the plot, and the guides and trained workers should help them in solving their problems. By farmers' excursions the Government farms will be advertised. Those farmers who did not hear the names of the Government or district farms will know them too. All such farms should not be maintained for mere show. They should be judged by their practical utility.

iv. Some of the trained workers will be travelling agricultural lecturers. Each of them will be furnished with a hand-bag which will contain samples of soil, litmus paper, one glass-stoppered bottle containing hydrochloric acid, picture postcards and charts on improved methods of farming, folding postcard and chart-hangers, publications on agriculture for free distribution, etc. These travelling lecturers will give illustrated talks at parks, at vegetable markets, at railway stations and in compartments while the train is in motion. They will also give demonstrations, as the following. The lecturer moulds a sample of moist soil into the form of a ball. He breaks the ball in two, inserts a piece of blue paper and then presses it firmly together. If the moisture of the soil turns the litmus from blue to red it will indicate that the soil is acid or sour. He then takes another sample of soil and pats it into a cake with a hollow in the upper surface. He then uses the hydrochloric acid to test the soil for the presence or absence of limestone by pouring a few drops of the hydrochloric acid in the hollow of the cake. If there be any foaming or effervescence, it will indicate that the soil contains limestone.

When I travel by train I carry lantern slides, picture postcards on improved methods of farming, charts, etc. and try to create an interest in agriculture amongst my fellow-passengers. This way of preaching the gospel of scientific agriculture to every child will make him interested in farming.

If the propaganda is rightly conducted the results will be wonderful.—S. SINHA, B.Sc., Senior Professor of Botany, Berhampore College, Bengal.

MGIPC—M—III-1-122—28-1-41—1,800.

INDIAN FARMING

ISSUED BY
THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

Vol. II : No. 3
MARCH 1941

Subscription : Rs. 6 per annum : 8 as. per copy

PUBLISHED BY MANAGER OF PUBLICATIONS, DELHI
PRINTED BY MANAGER, GOVERNMENT OF INDIA PRESS, CALCUTTA

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CONTENTS

Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Imperial Council of Agricultural Research, Imperial Secretariat, New Delhi.

The subscription is Rs. 6 per annum, 8 as per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertisements should be made to the Manager of Publications, Civil Lines, Delhi.

Subscribers in Europe and America should apply to the High Commissioner for India, Public Department (Publication Branch), India House, Aldwych, London, W.C.2.

INDIAN FARMING

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Vol. II MARCH 1941 No. 3

IMPROVING AGRICULTURE

At the basis of all arts and industries lies the production of the raw materials without which neither life nor civilization is possible. Such raw materials come directly or indirectly from the earth or the sea, and of all the groups of raw materials those derived from agriculture and animal husbandry are the oldest and most important.

This is a census year and we shall in due time be informed what proportion of people in this country is employed in agriculture and animal husbandry or is directly dependent thereon. At the last census this percentage was 67 (Census of India, 1931).

The following figures showing percentages of the population dependent on agriculture (including animal husbandry) as a livelihood in some other countries are given for comparison. These figures are of course taken from statistics* prepared before the present world upheaval.

	Percentage of the population dependent on agriculture
(1) United Kingdom	6
(2) Canada	28·7
(3) U. S. A.	22
(4) France	35·6
(5) Germany	28·8
(6) Italy	47·7
(7) Turkey	80
(8) Japan	22

* References:
(1), (4), (5) & (6)—League of Nations: European Conference on Rural Life, 1939: Series No. 3. *Population and Agriculture*, etc. (Document No. 1), p. 8
(2) *Canada Yearbook, 1939*, p. 187
(3) *American Yearbook, 1939*, p. 562
(7) *Foreign Agriculture*—Issued by U. S. Department of Agriculture, Vol. IV, No. 4, April 1940, p. 223
(8) *Japan Yearbook, 1938-39*, p. 44

Previous to the present war there had been a growing emphasis on the improvement and development of agriculture particularly in countries aiming at self-sufficiency. Any traveller in Germany in the years just before the war must have been struck by the way in which every available scrap of ground was being used to grow either wheat or potatoes, and with the concentrated drive to get as many people as possible (including students and holiday-makers) into the fields for work at the time of the harvest.

In Great Britain there has been, since the war began, an agricultural revival, and in a series of recent trenchant articles in *The Field* Lord Addison has dealt with the past, present and future of British agriculture. Extracts from some of these articles have been quoted in INDIAN FARMING.

In India the need is plain for whole-hearted, continuous and increasing attention to agriculture as the basis of national life and wealth.

Many departments of Government are concerned with the agriculturist. Of these the Agricultural and Veterinary Departments of provinces and states are specially charged with the work of helping him in his task of production, and also to some extent in helping him to realize a fair cash value for his products.

In their short lifetime these Departments on their observation and research side have accumulated a great body of knowledge, and on their propaganda or 'extension' side have been able to pass on a great deal of this to the cultivators.

The most recent of extension methods is dealt with in this issue in the article entitled 'The Project System Bridges the Gap'. The example of such a project (that put up by the

Central Provinces and Berar), given as an appendix to the article, tells more about this system than any amount of explanation. The reader will be well repaid by a close perusal of that scheme.

The soil, the crops, the methods of cultivation, the stock, and the cultivator himself will *all* receive attention in such a project and the cultivator himself will work it, under guidance. We expect great things from this system.

NEW YEAR HONOURS

THE New Year Honours List includes several names connected with service to agriculture and animal husbandry:

To be Companion of the Order of the Indian Empire

ARCHIBALD MACDONALD LIVINGSTONE, Esquire, M.C., Agricultural Marketing Adviser to the Government of India.

To be Commander of the Order of the British Empire

LIEUTENANT-COLONEL CHARLES ALLAN MACLEAN, M.B.E., M.C., Indian Agricultural Service, Cane Commissioner, Bihar, and Officer Commanding the Bihar Light Horse, A. F. (I.).

To be Officers of the Order of the British Empire

SUKUMAR BASU, Esquire, Indian Civil Service, Secretary, Imperial Council of Agricultural Research.

JOHN REID HADDOW, Esquire, M.R.C.V.S., D.V.S.M., Indian Veterinary Service, Veterinary Research Officer-in-Charge of Serology, Izatnagar.

To be Members of the Order of the British Empire

CECIL JOSEPH BOCARRO, Esquire, Assistant Secretary, Indian Central Cotton Committee.

KHAN SAHIB KHWAJA GHULAM HASAN, Cattle Show Officer, All-India Cattle Show Committee.

Knighthood

SORABJI DORABJI SAKLATVALA, Esquire, Member of the Bombay Legislative Assembly, Director, Messrs Tata Sons, Limited, Bombay (Member of the Indian Central Cotton Committee).

LALA SHRI RAM, Millowner, Delhi (Member of the Indian Central Cotton Committee and of the Sugar Committee of the Imperial Council of Agricultural Research).

Khan Bahadur

KHAN SAHIB BAZLUL KARIM, Secretary, Coal Mines Stowing Board, Calcutta (lately Superintendent, Imperial Council of Agricultural Research).

Rao Bahadur

SRI KODIALBAIL TIMMAPPA ALWA, Headquarters Deputy Director of Agriculture, Madras.

MR CHINTAMAN GOPAL PARANJPE, Agricultural Engineer to the Government of Bombay.

RAO SAHIB GANESH GOPAL SHEMBEKAR, Agriculturist, Baramati, Poona District, Bombay.

Sardar Sahib

SARDAR KARTAR SINGH, Marketing Officer, and Assistant to the Director of Agriculture, Punjab, Lahore.

Rao Sahib

SRI DAVID WILLIAM DEVANESAN, Assistant Director (Biology), Fisheries Department, Madras.

Original Articles

THE PROJECT SYSTEM BRIDGES THE GAP

By W. Burns, C.I.E., D.Sc., I.A.S.
Agricultural Commissioner with the Government of India

'*It must always be remembered that agricultural improvements require intelligence and care and that something more than the conversion of the individual is needed. The new methods must be welded permanently into rural economy.*'—*A. Howard and G. L. C. Howard*, Indian Agriculture, *1927*.

'*The betterment of other conditions in rural India can only be secured by the coordination of many factors, and the most important is the increase of the wealth of the farmer, the resultant of a combination of the many features which tend to higher production, the better marketing of what he grows and the creation of subsidiary interests which can in some way or the other add according to circumstances to his increased wealth.*'—*R. G. Allan*, An Outline of Indian Agriculture, *1940*.

At recent meetings of both the Advisory Board of the Imperial Council of Agricultural Research and of the Indian Central Cotton Committee there has been a good deal of discussion regarding what we are now calling 'projects'.* During the meeting of the Indian Central Cotton Committee at Lyallpur (Punjab) in November 1938, Sir Chunilal Mehta asked the writer to draw up the outline of a scheme on which money could be usefully spent in Bombay. The writer suggested trying out on cultivators' holdings improved systems of cultivation. Following up certain recommendations in Sir John Russell's report, Sir Chunilal Mehta emphasized the need for this type of work both in the Indian Central Cotton Committee and in the Imperial Council of Agricultural Research. In March 1939, the Indian Central Cotton Committee had before it the recommendations of a special sub-committee appointed to examine and report on the present position of Indian cotton. Among the recommendations of the special sub-committee were the following:

'The Committee notes that, while as a result of the joint efforts of the Indian Central Cotton Committee and the provincial Departments of Agriculture, some improvement in the outturn of cotton per acre in India has taken place, the yield still compares very unfavourably with other countries and in many areas is extremely low. It, therefore, recommends:

(i) the starting in major cotton-growing tracts of cotton cultivation projects which would be complete holdings or preferably villages managed and cultivated by the cultivators themselves according to the best system advised by the local Agricultural Department and where the results of research work could be concentrated in practice and demonstrated to growers under cultivators' conditions with the improved type or types of cotton best suited to each tract,

(ii) the keeping of accounts giving information as to the expenditure and income of the projects referred to above.

The Committee further recommends that such work should be carried out by the provincial Departments of Agriculture in collaboration with the Indian Central Cotton Committee in selected holdings or villages.'

Schemes to be comprehensive

At a later meeting (August 1939) the Agricultural Research Sub-Committee of the Indian Central Cotton Committee recommended that

* In some papers these have been referred to as *model* projects. It is better to omit the word 'model' as the adjective may tend to give a sense of artificiality. A project is essentially practical.

such projects should not be confined to one crop but should include all the crops grown in a holding and that such schemes should be worked conjointly with the Imperial Council of Agricultural Research. It was then agreed that in regard to recurring expenditure the distribution should be on the following basis:

50 per cent to be borne by the provincial Government,

25 per cent to be borne by the Imperial Council of Agricultural Research, and

25 per cent to be borne by the Indian Central Cotton Committee.

'Project' defined

The Advisory Board of the Imperial Council of Agricultural Research had discussed the same idea in their meeting of June 1939 and of November-December 1939. The latter meeting was the occasion of a long discussion on the level of expenditure and the area to be covered by such a project. It was considered important that a project should be carried out on a compact group of holdings or preferably a complete village. In May 1940, the Imperial Council of Agricultural Research addressed all provincial Governments and constituent states (except Bombay, which had already sent up a project scheme) and stated that the Council would be glad to consider any schemes which provinces and states might have to submit to give practical shape to the ideas expressed in the discussions. The Bombay scheme was mentioned as an indication of the kind of things suggested. The writer has in another place given his definition of a project as follows:

'A project (in the sense used by the Soil Conservation Service of America) is a planned system of land use, involving the simultaneous or coordinated application of a variety of measures of proved value. A project is carried out on the land of a farmer, and often by *him* (with the help or guidance of Government technicians), as a means of permanently improving his land, his cultivation practices, his production and his income. A project is most likely to be successful both technically and economically when it is carried out on a group of contiguous holdings, or, best of all, a whole village.'

The C. P. project

The ideas emphasized in the most recent discussions in the Advisory Board have been—

(1) the need for dealing with all the land in the project area (and not merely the cultivated land), and

(2) the need for including soil conservation practices in all projects.

Various project schemes have been received. Of these, a very useful one is the project put up by the Central Provinces Department of Agriculture. It is worth while quoting this in detail, and it is given as an appendix to this article. The expenditure comes to the modest sum of Rs. 9,553 over three years, of which Rs. 2,925 is non-recurring expenditure, Rs. 3,957 is for staff, and Rs. 2,671 is for contingencies. The non-recurring expenditure is largely for implements, appliances, breeding bull, etc. The staff consists of one Agricultural Assistant, one *jamadar*, one storekeeper, and contingencies cover cost of fertilizers, seed and a reserve for meeting possible losses arising out of the project, i.e. as compensation for those undertaking the project work, should there be any such loss. A point in this scheme that merits special notice is that in addition to the improvement of the technique and economies of farming, the improvement of the farmer as a man and of his social conditions receive attention.

The idea underlying a project is to 'put across' a whole group of improvements all at once. In other words, it is to teach an improved *system* of farming. This differs markedly from the old so-called demonstration which was generally confined to one item, was usually carried out by Government staff and might not be particularly related to the system of farming. The project is a system of farming carried out by the cultivator himself, the Government providing advice, assistance and, where necessary, implements and appliances that the cultivator may not immediately be able to purchase.

Bridging the gap

The success of this type of project has been very marked, particularly in the work of the Soil Conservation Service of America. In

pages of the journal of that Service, *Soil Conservation*, are given many examples of plans and drawings of holdings where changes have been planned and carried out and in which the bulk of the work has been done by the farmers themselves.

It is inevitable and even desirable that in different provinces and states projects should to some extent differ, but the basic idea must be everywhere the same. There also must be some way of judging the success or otherwise of a project. Should the improved system catch on among other farmers in the neighbourhood and be adopted by them of their own accord, there could, of course, be no better criterion of success. So far as estimating success numerically or quantitatively is concerned, the best test will probably be to find out whether the calculated increases in yields have been obtained or not. In some projects it is intended to have some simple form of book-keeping.

Anyhow, the schemes if approved by the Governing Body of the Council, will be launched next year and, apart from the actual good which they will certainly do in the villages where they are situated, they will form an important experiment in that bridging of the gap between the research station and the cultivator which has been so stressed in recent years.

APPENDIX

PROJECT FOR THE DEMONSTRATION OF AGRICULTURAL IMPROVEMENTS IN A VILLAGE IN AMRAOTI DISTRICT, BERAR

The most important feature of the agriculture of Berar is the concentration of cotton cultivation. During the boom period of the 'twenties' as much as 50 per cent of the cultivated land grew cotton. During the past quinquennium the acreage has fallen appreciably but is still about 2·7 million acres, representing roughly 11 per cent of the area in British India. The production is about 5 lakhs of bales annually.

Cotton is grown as an unirrigated monsoon crop and is sown with the onset of the rains in June. The rains continue till about the middle of September and from then onwards the crop is dependent upon the moisture stored in the soil. In normal seasons and with good cultivation, the rich and retentive soils of Berar are able to sustain the crop fairly well over the growing period. Sometimes occasional showers are received in October and November, but generally these do more harm than good for cotton. Generally speaking, more damage is caused by too much rain than by too little.

Berar has two distinct tracts—the ghats and the plains. The rich and retentive soils of the plains is the famous black cotton soil which has made cotton cultivation a success in Berar in the past in spite of the short rainy season. The ghats have a lighter soil but have the advantages of a heavier rainfall and cooler climate.

The cultivators, particularly of the plains, are intelligent, hardworking and thrifty. They are always willing to adopt improvements when convinced of the advantages of so doing. In many respects the agricultural practices of Berar show a great improvement over the rest of the province. Nevertheless, there is great scope for improvement. Outturns in general are low. The soil is subjected to erosion which, in some parts, is so serious as to threaten all prospects of successful crop production in the near future. Rotation is neglected; manurial resources are not conserved, and cultivation is perfunctory. Excessive devotion to cotton has in recent years brought the cultivator to the verge of bankruptcy.

The great cotton boom of the 'twenties' extended cotton to all grades of lands and this has resulted in reducing the outturn per acre; while the continuous cropping of all good land with cotton has resulted in impairing fertility very considerably. The unfavourable seasons, poor outturns and fall in prices which characterized the past decade have brought out very clearly the evils of this unbalanced economy. The need for a readjustment of farming policy and for an improvement of agricultural practices appear imperative. Agriculture must be made more efficient and remunerative. The means suggested for bringing this about are as follows:

(*a*) A substantial reduction in the area under cotton.
(*b*) Increasing per-acre outturns of all crops by an all-round improvement in farming practices.
(*c*) Reducing cost of production of crops.
(*d*) Introducing mixed or diversified farming and thereby enabling the cultivator to grow more of what he wants for his own consumption, to have more lines of cash income and to establish a more stable agriculture by paying more attention to the maintenance of soil fertility by producing more manure and by growing restorative crops.

The scheme outlined below is formed against this background and is in some respects a departure from the normal agricultural economy of Berar. The reduction in the area under cotton, the introduction of stock farming, and the emphasis on *rabi* crops are intended to wean the cultivator from his dependence on a single money crop and to introduce an element of stability in the rural economy.

It is proposed to locate the scheme in the village of Shirala in Amraoti district. This village is very typical of the conditions in the Berar plains and is also suitable for *rabi* crops. The area included in the project will be about 300 acres embracing 10 to 12 holdings.

PROGRAMME OF WORK

1. *Land development*
   (*a*) Providing surface drains for removing excess water.

(*b*) Providing field embankments along contour lines for the prevention of soil erosion.
(*c*) Levelling wherever necessary.
(*d*) Planting *marval* grass on the sides of drains and embankments.
(*e*) Eradication of perennial weeds like *kunda* and *kans*.

2. *Building up soil fertility*

A. Conservation of all manurial resources and manuring on an approved plan—

(*a*) Preserving farmyard manure by popularizing the use of pits.
(*b*) Preserving urine by the dry earth system.
(*c*) Utilization of all farm waste for preparing compost manure.
(*d*) Use of fertilizers for top-dressing cotton, mainly as a tonic after adverse weather.

B. Rotation of crops.—A three-course rotation will be followed.

Area in acres	1st Year	2nd Year	3rd Year
10	Cotton	*Jowar*	½ Groundnut ½ *Rabi*
10	½ Groundnut ½ *Rabi*	Cotton	*Jowar*
10	*Jowar*	½ Groundnut ½ *Rabi*	Cotton

C. More extensive cultivation of pulses and other legumes with a view to increasing the food supply and improving soil fertility.

3. *Use of improved seed*

Cotton—Verum 434.

It may not be safe to put all the area under a single variety on account of the vagaries of climatic conditions. A certain percentage of the area may therefore be put under other approved varieties such as Buri 107.

Grain *jowar*—Variety *Saoner* which is a higher yielder than local varieties.

Fodder *jowar*—*Jowar* is not now grown as a fodder crop. *Saoner* and *Sundia* varieties will be grown for fodder.

Groundnut—Variety AK 12-24.

Wheat—Variety *Bansipalli*.

This variety recently introduced from Bombay has been found to do well under Berar conditions.

Tur—EB3 which is a wilt-resistant variety.

Gram—Variety No. 28.

4. *Improved methods of cultivation*

(*a*) One-third of the area will be ploughed every year with an Inertion plough. Ploughing will be given to *rabi* and groundnut areas and will be followed by a disc harrow.
(*b*) Harrowing four times by using the local *bakhar* (blade harrow) for preparing seedbed.
(*c*) Seed treatment.

Cotton will be treated with Agrosan or other suitable starter before sowing. Where the seed is known to be infected with insect pests or fungus diseases it will be subjected to the necessary treatment in each case; e.g. sulphuric acid treatment for anthracnose, and exposing to the heat of the sun for bollworm. *Jowar* seed will be treated with sulphur or copper carbonate for smut. Groundnut seed will be treated with copper sulphate solution for preventing damage from birds.

(*d*) Sowing—Cotton will be sown by the *aryadu* which sows three lines at a time. The usual practice is to sow behind the *bakhar* which sows only two lines at a time. A four-tined seed drill will be used for sowing groundnut.
(*e*) Spacing

Cotton—18 in. between rows and 8 in. between plants.

Groundnut—12 in. between rows and 9 in. between plants.

The usual practice in Berar is to sow only 35 lb. per acre. This gives a very thin crop. A seed rate of 80 lb. will be used.

Grain *jowar*—18 in. between rows and 9 in. between plants.

It is a practice with some cultivators to grow a small percentage of *mung* or *urid* either in lines alternating with *jowar* or mixed with *jowar*. This is a sound practice from the point of view of soil fertility and will be followed.

Fodder *jowar*—12 in. between rows using a seed rate of 20 lb.

(*f*) Interculture—Maximum advantage will be taken of all opportunities for interculture afforded by breaks in the monsoon. Improved Akola hoes will be used.
(*g*) Weeding—This will be done after interculture as often as necessary.
(*h*) Roguing—All cotton fields will be thoroughly rogued for maintaining purity of the variety.
(*i*) Clean picking of cotton.
(*j*) Threshing—Clean and well-made threshing floors will be used for threshing *jowar*, wheat and other grains to avoid admixture of dirt.
(*k*) Winnowing—A winnower will be used in case of all grains and pulses.
(*l*) Storage of produce—All grains will be fumigated with carbon bisulphide or other suitable fumigant before storing, and airtight containers will be used.

5. *Introduction of diversified farming*

The aim is to bring about a balance between crop farming and stock farming. It is hoped that this will not only increase the cash income of the cultivator but will also ultimately result in an all-round improvement of cattle in general.

(i) Each holding will maintain milk buffaloes or cows on the basis of two to four milk animals for 30 acres of land. Buffaloes of the local Berari breed will be selected. Some of the cultivators already possess buffaloes. Government will be approached to grant *taccavi* loans for the purchase of whatever extra stock is required.

(ii) Maintenance of a stud bull on a cooperative basis.

(iii) Feeding standard rations to milch animals. Silage will be prepared and oil-cakes will take the place of cotton seed. *Kadbi* will be chaffed before feeding. Groundnut fodder will be preserved for feeding.

(iv) Castration of inferior stock and elimination of uneconomic animals.

(v) Cultivators who have no objection to keeping poultry will be encouraged to do so. Suitable poultry houses and Leghorn cocks will be provided.

6. *Subsidiary industries*

(*a*) Production of ghee—Improved methods will be popularized. A separator will be provided and will be used by all the cultivators. Metal vessels will be used in place of the local earthen pots.

(*b*) Rope-making will be encouraged.

7. *Organization of cultivators*

A. A village farmers' society will be organized on cooperative lines. It will take up the following functions:

(1) Cooperative purchase of all agricultural requisites such as manures, seeds, implements, fungicides, etc.

(2) Cooperative sale of agricultural produce—Cotton and groundnut will be pooled and graded before selling. The sale of ghee and eggs will also be undertaken on a cooperative basis.

(3) Crop protection—Watching of crops, prevention of damage from wild animals and protection from diseases and pests will be undertaken on a cooperative basis.

(4) Cattle improvement—Maintenance of a stud bull and arrangements for castration and inoculations will be done on a cooperative basis and will embrace the whole village, if possible.

(5) Improvement of social conditions—Propaganda will be made to reduce expenditure on marriages and festivities and to encourage thrift and better living.

B. Organization of shows and demonstrations with a view to bringing improvements to the notice of the neighbouring villages. Expenditure on account of this will be met by the provincial Department.

C. Provision of education and entertainment to the villagers—The village already possesses a radio set. *Bhajan* clubs and village dramas on matters dealing with the improvement of the village and rural reconstruction will be organized.

8. *Miscellaneous improvements*

(*a*) Simple accounts will be maintained for all the holdings that come within the scheme.

(*b*) There is little by way of grazing facilities in this village. It consists only of a few acres of waste land. Trees will be planted for providing shade in this area.

(*c*) Tree planting will be encouraged, in areas where this does not interfere with the crops, to provide fuel so that the use of cattle dung for fuel will be reduced to the minimum.

Budget Estimate of Expenditure on the Scheme over a Period of Three Years

A. Capital (Non-recurring) Expenditure

(*a*) *Provision of improved implements*	Rs.
Five iron ploughs at Rs. 40 each .	200
Five four-tined seed drills for *jowar* at Rs. 10 each	50
Ten pairs of improved hoes at Rs. 12 per pair	120
Five seed drills for groundnut at Rs. 7 each	35
Five pairs of hoes for groundnut at Rs. 5 per pair	25
Two land-levellers at Rs. 30 each .	60
Five sets of plough chains at Rs. 12 each	60
One cream separator	150
One winnower	150
One disc harrow	200
Total .	1,050
(*b*) *Office furniture*	50
Total for implements and furniture	1,100
(*c*) *Other capital expenditure*	
Land development at Rs. 5 per acre	1,500
One breeding bull . . .	200
Rope-making machine . .	50
Miscellaneous dairy appliances .	75
Total .	1,825
Total capital expenditure (non-recurring)	2,925

B. Recurring Expenditure

—	1st Year	2nd Year	3rd Year	Total
Establishment—	Rs.	Rs.	Rs.	Rs.
1. One Agricultural Assistant on a scale of Rs. 70—70—75—5—100 .	840	840	900	2,580
2. One *jamadar* on a scale of Rs. 20—1—30 . .	240	252	264	756
3. One storekeeper on Rs. 11 . .	132	132	132	396
4. Travelling allowance of the staff . .	75	75	75	225
Total Establishment .	1,287	1,299	1,371	3,957
Contingencies—				
1. Office expenses and Miscellaneous .	125	125	125	375
2. Rent for office and godown . .	120	120	120	360
3. Cost of fertilizers at the rate of ⅓ area each year . .	303	303	303	909
4. Half the cost of cotton seed required for sowing	22	..	..	22
5. Half the cost of groundnut required for sowing .	105	..	..	105
6. Reserve for meeting possible losses arising out of the project . .	300	300	300	900
Total Contingencies .	975	848	848	2,671
Total Recurring . .	2,262	2,147	2,219	6,628

TOTAL RECURRING AND NON-RECURRING EXPENDITURE

Item	Amount required			
	Years			
	1st Year	2nd Year	3rd Year	Total
	Rs.	Rs.	Rs.	Rs.
A. Capital expenditure (non-recurring) .	2,925	..	..	2,925
B. Recurring expenditure				
(a) Staff . .	1,287	1,299	1,371	3,957
(b) Contingencies .	975	848	848	2,671
Total .	5,187	2,147	2,219	9,553

The increased cost per holding (30 acres) required for the introduction of the proposed improvements.

Item—Capital (non-recurring)

	Rs.
Land development . . .	150
Purchase of new implements . .	105
Total .	255

Recurring (annual)

Maintenance of *bunds* and drains	10
Top-dressing with 40 lb. ammonium sulphate, per acre of cotton	30
Extra cost of interculturing operations	30
Total .	70

The increased cost per holding required for the introduction and extension of other improvements.

Item—Recurring (annual)

	Rs.
Contribution towards maintaining bull	15
Compost-making	5
Total .	20

Total extra cost per holding of 30 acres comes to :

Capital (non-recurring)	255
Recurring	90

The estimated increase in financial return per holding due to the adoption of the proposed improvements is as under :

Item	Percentage increase			
	Cotton	*Jowar*	Groundnut	Wheat
Land improvement .	5	5	5	5
Rotation of crops .	5	5	5	5
Manuring . . .	25	15	15	15
Improved tillage .	10	5	5	5
Improved variety of seed . . .	5	10	15	5
Total .	50	40	45	35
Increased yield in lb. .	1,500	2,000	1,575	1,050
Increased monetary return . . .	Rs. 187	87	79	52
Total increase .	Rs. 405			

In addition, the increased income per holding resulting from milch cattle and cooperative marketing of farm produce is estimated as below :

	Rs.
Sale of ghee	150
Better marketing	30
Sale of livestock	20
Total .	200

The total increased profit per holding comes to Rs. 605. Deducting from this the total extra recurring expenditure of Rs. 90 the annual extra net profit would be Rs. 515 per holding or Rs. 17 per acre. The capital expenditure of Rs. 255 per holding is negligible when compared with the extra net profit.

THE GOLD IN THE DIRT

By W. M. Clark, M.B.E., B.Sc., I.A.S.
Principal, Bengal Agricultural Institute, Dacca

THE title has been chosen to trap readers of this magazine into considering once more a subject with which many are probably bored, namely that of increasing the supply of manure, and the trap has been laid to find out what results have actually been secured in the various provinces and states. All Agricultural Departments claim to have done much work with the making of artificial farmyard manure. How many can claim to have got cultivators to take up their methods ?

Ever since Sir Albert Howard directed attention once more to an old problem a tremendous amount of experimental work has been done and many reports given the latest of which in this journal is that headed *Composts and Soil Fertility* by C. N. Acharya, M.Sc., Ph.D., A.I.C., in the February and March issues of 1940. As with so many others on the same subject, it is an exceedingly interesting and well-written account of sound work, but it does not tell what many of us would like to know—the number of cultivators actually carrying out the methods recommended and the amount of manure so made. The impression of the writer is that very little of that work has been included (or again included since the process is not a new one) in the routine of cultivators anywhere, but as he may be wrong he is going to state what has been accomplished in Bengal in the hope of securing similar reports from other areas.

Manure in Bengal

Much of the land of Bengal is in the happy position of not needing to bother about manure as it receives a yearly deposit of silt, but vast areas are now above flood-level while the Ganges and Brahmaputra bring down sand as well as silt and these areas need manure particularly if they are to grow cold-weather crops such as potatoes. The Department has always taken much interest therefore in the turning of plant rubbish into manure and had it not taken an interest it would have been compelled to do so in any case because of the problem of water hyacinth. The multiplication and spread of this weed is the concern of practically all of the *aman** paddy growers on an area of 17,000,000 acres and naturally of every Department of Government since it can choke water-channels, drift over and drown the deep-water paddies and often make the subsequent cultivation and working of these areas impossible.

The first line taken by the Bengal Agricultural Department was to evolve during the period 1916-18 methods for the extraction of potash salts from the ash which contains 28·7 per cent K_2O. The green plant, however, contains only 1 per cent of ash and 95 per cent of moisture which makes the drying of it a laborious and never-ending process. The subsequent treatment of the ash is easy, but the cash return for all the labour used is very small and cultivators have never persisted with the method evolved for them. In any case, in the areas where water hyacinth is most abundant the land available for drying the weed is scarce.

Sound results achieved

That effort having failed, the next investigation was directed towards making artificial farmyard manure and with that, and the conversion of field weeds into manure, the Department claims to have achieved sound results. Experimental work was begun in 1921 and the analysis of the manures made on

* A Bengal term for rice sown or transplanted in low lands and harvested in November-December.

the Dacca Farm in 1926 shows the following figures :

—	Farmyard manure	Artificial farmyard manure from field weeds and sugarcane leaves	Artificial farmyard manure from water hyacinth
Moisture	49·67	56·05	84·78
Nitrogen	·71	·57	·22
The nitrogen on a dry basis is therefore :			
	1·41	1·29	1·44

The method used involved the addition only of water.

Since then various further experiments and analyses have been made and among these we may note one at the same farm in 1928.

—	Artificial farmyard manure from field weeds and sugar-cane leaves		Artificial farmyard manure from water hyacinth
	Made with water only	*Made with Adco*	*Made with bone-meal and cattle urine*
Moisture	42·89	46·15	51·97
Nitrogen	·498	·610	·616
Do. dry basis	·87	1·13	1·28

Difficulties

There is no record of the temperatures reached, the time taken to reach the temperature, etc. and to that extent the conditions were only those in which an intelligent cultivator might have made the manures by these methods. It is impossible to say, therefore, from the figures that, for the conditions prevailing in Bengal and for certain specified materials, any one particular method of handling is better than another. Work on that will no doubt be done for use on Government farms. But for officers of the District staff such information is of little help in dealing with the average cultivator. For such an officer struggling against the inertia caused in cultivators by malaria, in areas of too much or too little rain, of high and low flood-levels, among a population whose womenfolk rarely help their men in the fields, what is easiest is best. He is even rather against having his demonstrators instructed in the ideal method since ideal methods involve the learning of new habits and to persuade cultivators to that end requires more than mere talking by a demonstrator. Cultivators know quite well that more farmyard manure would give them bigger crops, but harvest time is a long time ahead and much may happen before then. Funds are required and a well-trained staff.

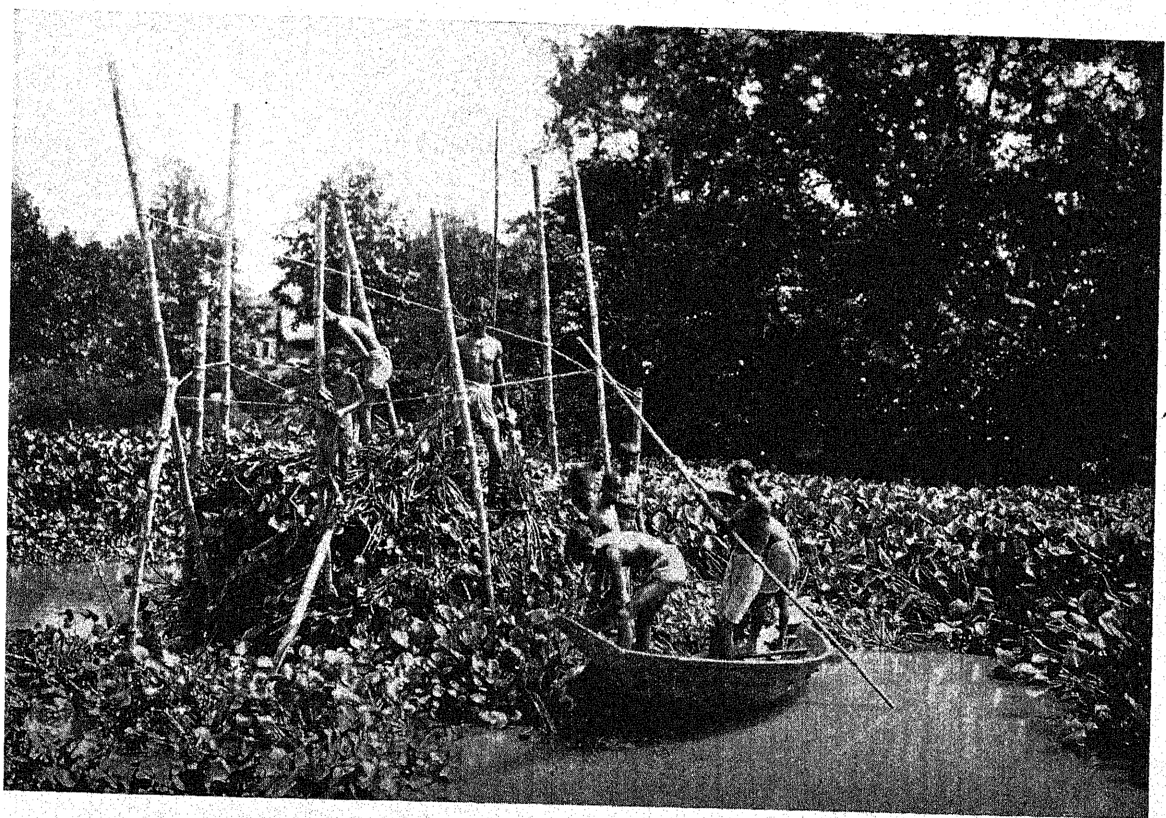
It is only in the last three years that the Bengal Agricultural Department has had a real opportunity to make progress with this work. The work done and enumerated by Agricultural Department officers alone in 1938-39 may be judged from the fact that in two of the three circles into which Bengal's 30,000,000 or so cultivated acres are divided 24,000 md. of 82 lb. each were made in one circle and 29,000 md. in another. Not all of that manure was made by cultivators, but, taking the circle in which the 24,000 md. were made as an example, just under 11,000 md. were made on seven Government farms and the balance of over 13,000 md. made by cultivators on their own land at 42 Union Board farms and 120 demonstration centres. The area of each Union Board farm is roughly five acres and that of each demonstration centre 10 acres or a total of 1,410 acres on which departmental crops were grown. The amount of manure made for use on these areas was therefore only 9 md. per acre as compared with over 20 md. per acre (gross area) produced on Government farms.

Good quality manure

The quality of the manure made from water hyacinth by cultivators is shown from the 13 random selections made from 60 samples collected and analysed and given below :

Percentage of moisture	Percentage of nitrogen	Percentage of nitrogen on a dry basis
78·99	·30	1·43
87·60	·22	1·70
71·00	·36	1·26
63·60	·31	·87
64·60	·28	·70
70·78	·48	1·64
37·72	·36	·58
15·16	·77	·91
29·76	·51	·70
36·87	1·62	2·57
33·58	·26	·39
39·11	·44	·72
13·00	·86	1·00
Average	·52	1·12

Navigation under difficulty



Cultivators have to contend with luxuriant growths of water hyacinth, It is extremely difficult to make heaps of a heavy weed on land mostly covered by water

A raft of water hyacinth—deep water paddy behind obviously in danger of being overwhelmed

Scenes during Water Hyacinth Week. The picture below shows a group interested in the application of iodine to a cut in a worker's limb

All that is demanded of cultivators, as in the Water Hyacinth Weeks mentioned later, is that they collect their weeds and heap them up, but on the Union Board farm and other demonstration centres the demonstrators show how the rotting can be accelerated by flinging on to the heaps a slurry of fresh cowdung and water in order to create a sharp rise in temperature. These heaps are covered, but not too efficiently in the drier tracts, as a leaky roof saves bother in carrying water. Anything further than that we reckon should be done by means of special classes to enquiring cultivators at Government farms.

Obviously much remains to be done, but, on the other hand, the above figures represent only a small part of the manure made and used as the Department is being helped considerably by the Water Hyacinth Weeks organized by the Bengal Government each year during which all officials are allotted areas within which they are expected to induce people to arrange for mass collection of the weed from adjacent *bils*, tanks and slow-flowing streams.

Finally, it is not claimed that the men who, without other inducement, are known to have continued on their own the simple practices advocated and shown to them, will all continue to do so as the factors influencing the decision of cultivators are not in the control of any Department. Cultivators must have a powerful inducement to make them persist in the regular and thorough attention required to secure a good product. Among the factors favouring the continuance of this work are high prices and smallness of area per cultivator. We have the latter in Bengal but no control over the former and in respect of area it is possible to have so small an area as to make even a 50 per cent increase of crop appear to many to be hardly worth the bother. As with so many other human affairs, we must await the rise of a real desire for a better standard of living. All we can do at present is to demonstrate how to make the manure and its value, but if Departments in other provinces can secure a higher standard than we do in Bengal we should like to know what they do and the actual results.

A few photos of work done during the last Water Hyacinth Week accompany this brief note and enquiry.

The most important resource available to man is knowledge, for the materials and forces in his environment become useful to him only as he learns about them, and through science and technology converts them to his needs.—Dr Wesley C. Mitchell, Director, National Bureau of Economics Research, New York (in *Nature*, November 2, 1940).

THE COCONUT PALM BEETLE AND ITS CONTROL

By

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and

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ALMOST every coconut cultivator is familiar with the beetle, *Oryctes rhinoceros* (Linn.). It is about two inches in length, black or reddish black in colour, of strong build and with a characteristic horn projecting dorsally upward from the head (Plate 33). The beetle is usually found in the crowns of coconut trees or at times in dung or compost pits where it actually breeds. The beetle often does severe damage to coconut palms. It is reported to be a serious pest in almost all parts of India, such as Bengal, Bombay, Madras, Mysore, Cochin and Travancore. Outside India it occurs as a pest in several countries, e.g. Burma, Ceylon, Malaya, Sumatra, Java, Celebes, the Philippine Islands, Fiji, etc.

Nature of damage

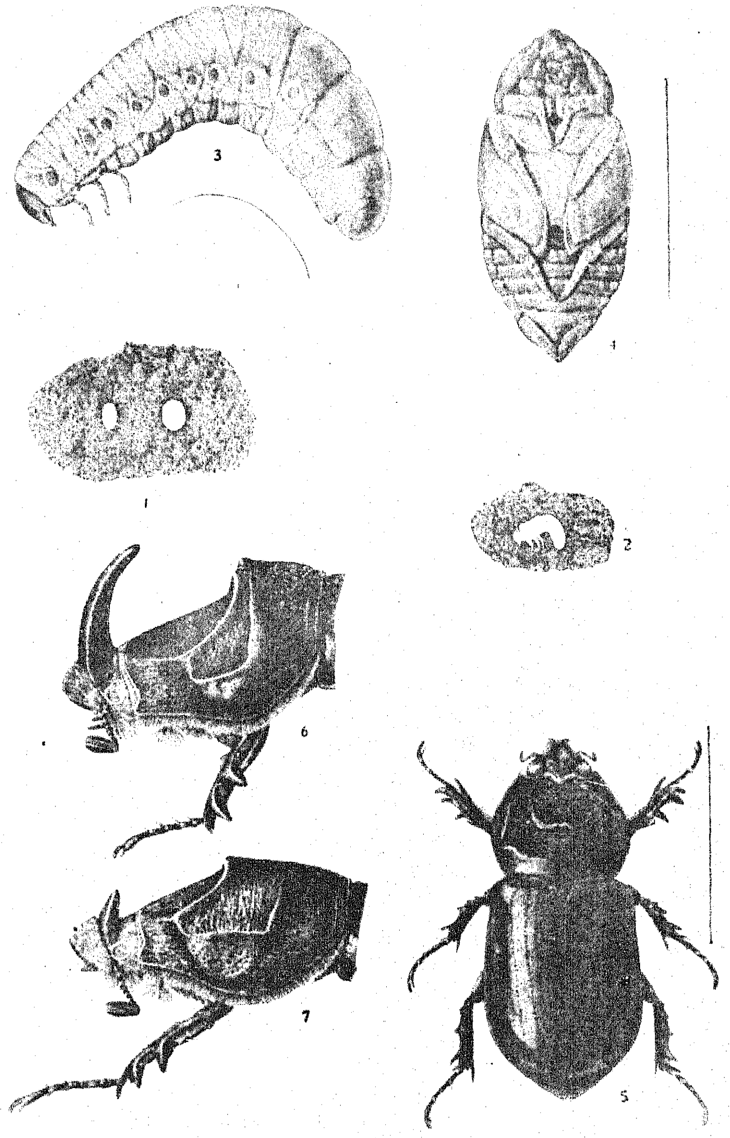
The beetle lives in crevices between leaf sheaths near the crown and begins to burrow into the softer portions. The tender leaves in the folded conditions are cut across and frequently the leaf stalk weakened by holes along its length. As a result, the unfolded leaf bears characteristic clippings or holes in leaflets (Plate 34), or the leaf itself breaks off (Plate 34) in the region of the hole on account of winds during monsoon weather. A number of young leaves are affected in this manner and by repeated attack the crown region is weakened considerably and stunted growth results. Injury to spathes is also common, resulting in loss of nuts directly. Not infrequently, young seedlings are bored through just at the point of the sprout in which case they are killed outright. Besides the above forms of direct injury, the beetle is an unwelcome visitor in other ways. The coconut palm weevil (*Rhynchophorus ferrugineus* F.) is readily attracted to coconut trees infested by *Oryctes rhinoceros* because of the holes caused by the latter which the weevil likes for egglaying. Again, rain water may collect in the holes in the damaged portions leading to decay due to fungus and other diseases.

Habits of the beetle

The palm beetle, in its adult stage, spends most of its time in the coconut trees where it gnaws the plant tissue, feeds on sap, throws the fibres out and remains in safe shelter. For laying eggs, the beetle enters manure pits or undisturbed heaps of decaying vegetable matter. As many as 140 eggs distributed over a number of days are laid by a single female. The beetle itself has been found to live for more than 290 days, feeding all the time and laying eggs intermittently, during almost all parts of the year in South India. In the same manner, the beetles are found in the crown of trees during all months of the year, but in appreciably larger numbers during the hot dry months of March to May. Five to six beetles are generally found per tree. The beetles are as a rule active after dusk, lying quiescent during day-time in the trees or in pits, avoiding light.

Habits of immature stages

The eggs (Plate 33) which are oval, creamy-white and fairly big (3×4 mm.) are easily seen in moist dung or decaying coconut trunks enclosed in bits of dung or breeding material. The young grubs feed on dung or decaying vegetable matter and grow rapidly to a size of 90-100 mm. in the course of about $1\frac{1}{2}$ months.



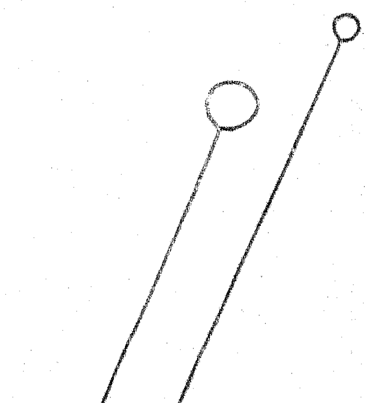
Oryctes rhinoceros (Linn.)

FIG. 1. Eggs, that on left newly laid, that on right about to hatch
,, 2. Young larva, natural size
,, 3. Full-grown larva
,, 4. Pupa
,, 5. Beetle
,, 6. Beetle, side-view of head of male, enlarged
,, 7. ,, ,, ,, female, ,,

The natural sizes of the stages shown in figures 3-5 are indicated by the hair-lines alongside each figure.

Three trees of the same age, one showing stunted growth due to repeated beetle attack

Showing holes in petioles, and broken leaf stalk, due to beetle attack



1. Beetle rod
2. Beetle rod with hooked out beetle

Almost every ryot is familiar with these fleshy white grubs (Plate 33) in manure pits. In tracts of vast stretches of coconut cultivation, sometimes 300-400 grubs can be found in about a month, even in a small manure pit of the size 4 ft. × 4 ft. indicating the enormous breeding activity of the beetles. When full grown, the grubs seek shelter at the sides and bottom of the pits, where they construct earthen cells for pupation. In the pupal stage (Plate 33) covered over with earth in the shape of a ball, the specimens are not easily seen. They are buried in earth to a depth of 1-3 ft. and more, according to moisture condition of the medium, and from these cells the beetles emerge in due course. They make their way out of the earth or dung and fly to the tree. The life cycle from egg to adult takes about 3½ to 8 months, but the period is found to vary enormously for different localities.

Alternate food plants

The adult beetles are found to attack and feed on a variety of plants, the most common of which are the coconut palm, the talipot palm, the date palm, the palmyras, the African oil palm and the aloes and on rare occasions it also attacks sugarcane. We are not aware of any variety of coconut palm which is immune to this pest.

Control methods

Control methods are aimed at destruction of beetles in trees and secondly treatment of breeding places to check the multiplication of the beetles to reduce future attacks.

The beetle can be removed and destroyed from infested crowns by means of a metal rod (Plate 34) about 2½ ft. long and ⅜ in. thick, with a hook and sharp point at one end and with the other end bent so as to form a ring for gripping. The pointed end is inserted to extract the beetle from the holes. A climber can easily be trained to collect and destroy the beetle in this way. For preventing further entry of beetles, the holes and affected axils of leaves are filled with sand. By systematic removal of beetles and sanding the holes to prevent future entry considerable relief is secured.

As regards checking the multiplication of beetles, the gardens have to be kept clean of fallen logs, tree stumps or accumulation of moist rubbish. The manure and compost heaps should be raked up and the material spread over the surface at least once in three months. Every ryot knows that crows pick off the grubs from spread out manure, and thus by this process at intervals the majority of the grubs are effectively destroyed. Recently, a method of destruction of immature stages of beetles in manure heaps, without disturbing the heaps, has been advocated by the Department of Agriculture in Ceylon and this involves the cultivation and inoculation of a green muscardine fungus (*Metarrhizium anisopliæ*) into the manure pits. The fungus is parasitic on the grubs and pupæ and is capable of destroying them. This fungus is being tried in different localities in the Madras Presidency and it is yet premature to give any definite views regarding its utility under Indian conditions.

BERSEEM SEED PRODUCTION

By S. C. Roy, M.Sc., B.Sc. (Lond.), Dip. Agri. (Wye), Assoc. I.A.R.I.
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THE importance of cattle as a factor in maintaining soil fertility needs no introduction. In a country like India where an appreciable part of cattle manure is used as fuel, the problem of maintaining soil fertility has been a constant one. This problem has in recent years been intensified by the introduction of higher-yielding varieties of crops and by the opening up of large tracts of agricultural country which had hitherto remained uncultivated due to the want of one or more factors in crop production. In a summary prepared for the United Provinces Department of Agriculture in 1934, the author touched this question of the maintenance of soil fertility in the face of the introduction and rapid expansion of higher-yielding crops and showed how the availability of cheap and ample water in the tracts opened up by the Sarda Canal in the United Provinces intensified the problem by stimulating larger outturns for the moment and thereby allowing inroads on soil fertility which hundreds of years of an earlier system of farming with less exhaustive crops had stabilized.

Remedies for decreasing fertility

Various remedies have been suggested from time to time to cope with this problem, as for instance the extensive practice of mixed farming, a large-scale campaign for composting vegetable refuse and the inclusion of renovating crops in rotations. Mixed farming is a system in which the production of animal products, such as milk, is carried on side by side with a cropping system in which leguminous fodder crops take an important place and in which full use is also made of the increased quantities of cattle manure. In his *Report on the Development of the Cattle and Dairy Industries of India*, Dr N. C. Wright has observed: 'If full advantage is to be derived from irrigation, I am convinced that farming in irrigated areas will have to be modified to allow the inclusion of a mixed farming system in which both the crop and animal husbandries play their part.' Again, Sir John Russell in his *Report on the work of the Imperial Council of Agricultural Research in applying Science to Crop Production in India* has shown how only a few provinces in India grow a small proportion of fodder crops to their total sown area. He has very rightly remarked that a wider introduction of fodder crops into general agriculture would probably effect great improvements in yield and in total output. More food for the animals would mean more manure and enhanced fertility of the soil. He has also shown the dual role that leguminous crops play in the preservation of soil fertility. They particularly enrich the soil on which they grow by nitrogen fixation through their nodule bacteria, and secondly they provide food for animals and thus increase the quantity of farmyard manure, which when applied, enriches the ground. Berseem is one of the best fodder crops and when included in mixed farming rotations, it gives wonderful results. Its virtues as summed up by different writers are that

(i) its use prevents the diminution of the store of humus in the soil,

(ii) it is particularly good for opening up the soil,

(iii) it possesses high manurial value for the crops which follow it, and

(iv) it is the only food of the working and dairy animals belonging to cultivators between December and June.

This article attempts to examine the role of berseem in Indian agriculture in the immediate past, the present situation with regard to the cultivation and the obstacles in the way of berseem being taken up as a definite crop in the rotations of the intensively farmed tracts all over India.

From Egypt to India

Various workers have from time to time given interesting accounts of the introduction and the successful growing of berseem as a

fodder crop in different parts of India. Henderson and Mann have both shown the importance of berseem to Sind and how it gave excellent results at Mirpurkhas. Details of the introduction of berseem in the Punjab are given by Captain A. S. Marriot and by the reports issued by the Department of Agriculture, Punjab. The report of the Agriculture Department, Bihar and Orissa, for 1931-32 says that it has been definitely established that heavy crops of berseem can be grown on the Chota Nagpur plateau and in south Bihar. According to A. M. Mustafa, berseem has been introduced successfully in the North-West Frontier Province.

Thus it has been amply established that berseem, since its introduction from Egyptian sources, has done well and has a bright future for it under Indian conditions.

Present position

The present position with regard to the large-scale growing of berseem in the various provinces and states has been described by Sir John Russell : 'It grows well in northern India (North-West Frontier Province, Sind, the Punjab, United Provinces and Bihar) under irrigation. It has given striking results in Sind in that it can be sown in the cotton just after the last picking and that in this province it has the added advantage of being *kallar*-resistant and useful in the reclamation of saline land. Mr C. H. Parr has experimented with berseem as a catch crop and the extension of this type of work is recommended.' I can say from personal experience that berseem does very well when broadcast on early paddy stubble and that it can therefore enable such lands to be treated as *dofasli* (double-crop).

The most difficult problem with regard to a wider introduction of berseem is, however, the availability of pure berseem seed at a moderate price. The seed is generally impure and contains a large amount of dirt and weed seeds like chicory, wild mustard and dodder. Dodder is a parasitic plant and is a very dangerous enemy of berseem and all samples should be carefully inspected for this and, if unsatisfactory, rejected. Chicory is dangerous because it tends to create scouring in animals, and though its amount in the growing crop appears to decrease after each cutting, it is still very dangerous. Mustard gives a bad smell to milk and butter when contaminated berseem is fed to animals. Berseem is a shy seeder in different parts of India and the Frontier Province is the only place where its seed has been successfully and amply produced so far. Indeed, the North-West Frontier Province is the chief source of most of the seed obtainable in this country. Sir John Russell emphasized this difficulty of getting pure seed in sufficient quantities, but thought that a wider area of supply could no doubt be developed.

I C A R takes up the work

The Imperial Council of Agricultural Research is naturally alive to this problem which militates against the large-scale inclusion of such an important crop in general all over India. In the Special Joint Committee of the Advisory Board and the Governing Body held in July 1938 two important resolutions were passed :

(i) that the Imperial Agricultural Research Institute should be requested to investigate the technical difficulties in the setting of berseem seed, and

(ii) that provincial Agricultural Departments should also study the question of berseem seed production.

Thus, the problem has been taken up both centrally and provincially and important results are expected in the near future. A summary of the replies from the various provinces and states with regard to Resolution (ii) is given below :

Punjab. Steps are being taken for increased production of berseem seed and the fodder specialist is studying the conditions under which setting takes place in the North-West Frontier Province.

Madras. Attempts at growing berseem failed in 1938-39. In 1939-40 fresh seed was obtained from the North-West Frontier Province and Egypt and tried again. It was found that the crop can be successful if grown in suitable months. (The problem here is more of growing berseem in the first place than of seed production.)

North-West Frontier Province. Berseem seed

BERSEEM SEED PRODUCTION

By S. C. Roy, M.Sc., B.Sc. (Lond.), Dip. Agri. (Wye), Assoc. I.A.R.I.
Assistant Agricultural Commissioner with the Government of India

THE importance of cattle as a factor in maintaining soil fertility needs no introduction. In a country like India where an appreciable part of cattle manure is used as fuel, the problem of maintaining soil fertility has been a constant one. This problem has in recent years been intensified by the introduction of higher-yielding varieties of crops and by the opening up of large tracts of agricultural country which had hitherto remained uncultivated due to the want of one or more factors in crop production. In a summary prepared for the United Provinces Department of Agriculture in 1934, the author touched this question of the maintenance of soil fertility in the face of the introduction and rapid expansion of higher-yielding crops and showed how the availability of cheap and ample water in the tracts opened up by the Sarda Canal in the United Provinces intensified the problem by stimulating larger outturns for the moment and thereby allowing inroads on soil fertility which hundreds of years of an earlier system of farming with less exhaustive crops had stabilized.

Remedies for decreasing fertility

Various remedies have been suggested from time to time to cope with this problem, as for instance the extensive practice of mixed farming, a large-scale campaign for composting vegetable refuse and the inclusion of renovating crops in rotations. Mixed farming is a system in which the production of animal products, such as milk, is carried on side by side with a cropping system in which leguminous fodder crops take an important place and in which full use is also made of the increased quantities of cattle manure. In his *Report on the Development of the Cattle and Dairy Industries of India,* Dr N. C. Wright has observed: 'If full advantage is to be derived from irrigation, I am convinced that farming in irrigated areas will have to be modified to allow the inclusion of a mixed farming system in which both the crop and animal husbandries play their part.' Again, Sir John Russell in his *Report on the work of the Imperial Council of Agricultural Research in applying Science to Crop Production in India* has shown how only a few provinces in India grow a small proportion of fodder crops to their total sown area. He has very rightly remarked that a wider introduction of fodder crops into general agriculture would probably effect great improvements in yield and in total output. More food for the animals would mean more manure and enhanced fertility of the soil. He has also shown the dual role that leguminous crops play in the preservation of soil fertility. They particularly enrich the soil on which they grow by nitrogen fixation through their nodule bacteria, and secondly they provide food for animals and thus increase the quantity of farmyard manure, which when applied, enriches the ground. Berseem is one of the best fodder crops and when included in mixed farming rotations, it gives wonderful results. Its virtues as summed up by different writers are that

(i) its use prevents the diminution of the store of humus in the soil,

(ii) it is particularly good for opening up the soil,

(iii) it possesses high manurial value for the crops which follow it, and

(iv) it is the only food of the working and dairy animals belonging to cultivators between December and June.

This article attempts to examine the role of berseem in Indian agriculture in the immediate past, the present situation with regard to the cultivation and the obstacles in the way of berseem being taken up as a definite crop in the rotations of the intensively farmed tracts all over India.

From Egypt to India

Various workers have from time to time given interesting accounts of the introduction and the successful growing of berseem as a

fodder crop in different parts of India. Henderson and Mann have both shown the importance of berseem to Sind and how it gave excellent results at Mirpurkhas. Details of the introduction of berseem in the Punjab are given by Captain A. S. Marriot and by the reports issued by the Department of Agriculture, Punjab. The report of the Agriculture Department, Bihar and Orissa, for 1931-32 says that it has been definitely established that heavy crops of berseem can be grown on the Chota Nagpur plateau and in south Bihar. According to A. M. Mustafa, berseem has been introduced successfully in the North-West Frontier Province.

Thus it has been amply established that berseem, since its introduction from Egyptian sources, has done well and has a bright future for it under Indian conditions.

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North-West Frontier Province. Berseem seed

is produced in large quantities. Indeed this province is the chief source of Indian berseem seed. Setting takes place easily. The only trouble is that seed gets contaminated with chicory and other weeds and careful roguing has to be done to ensure purity of seed.

Bihar. Berseem sets freely in the Ranchi plateaux under suitable irrigation and soil conditions, but large-scale seed production is restricted for want of suitable land and funds.

Assam. The hot moist climate and the highly acidic soil are not favourable to berseem seed production and small-scale experiments in this direction led to nothing.

Bombay. Production of berseem seed has been tried at Padegaon and Manjri. At both the places the crop was sown in the end of October; one cutting was taken in January and thereafter the plots were left for seeding. Setting was easy—250 lb. to 300 lb. at Manjri and 300 to 400 lb. at Padegaon was the yield of seed per acre. There is, however, little demand for berseem as lucerne is favoured.

Bengal. Attempts at growing berseem have so far failed.

Sind. Berseem has been found to be a shy seeder here. Under good soil conditions the average yield per acre is about 320 lb. Manurial trials are being undertaken to increase seed yield.

United Provinces. Berseem is grown on many of the farms as a fodder crop and on a number of cattle-breeding farms. Part of the area is reserved for seed production. Arrangements are being made for growing it on a large scale. It has been suggested that work regarding isolation of suitable strains for high fodder outturn and suitable nodule bacteria should be started at the Centre.

Central Provinces. Seed sets freely in the northern part of the provinces only, viz. Saugor and Jubbulpore, but there is no demand for seed except on Government farms.

Orissa. Satisfactory crops of berseem have not been raised so far.

Baluchistan. The problem of seed production is under investigation.

Coorg. Berseem seed from the North-West Frontier Province was twice tried at different farms but failed. The crop is not suitable for Coorg.

Ajmer-Merwara. Production of berseem is being experimented with.

Delhi. Seed production is receiving special attention and the province is trying to make itself self-supporting as regards berseem seed.

Baroda. Little berseem seed is grown and seed production is not worth aiming at as the requirement is very meagre.

Cochin. Cultivation of berseem was tried but the trial was unsuccessful.

Mysore. Arrangements are being made for the multiplication of berseem seed.

Travancore. Berseem is not a crop of any importance here.

Bhopal. Trials will be undertaken to grow berseem.

Jammu and Kashmir. Berseem seed can be produced successfully in the Kashmir Valley.

Hyderabad. Deputy Directors of Agriculture have been asked to undertake trials for seed production.

Difficulties in cultivation

This summary clearly indicates two things:

(1) the successful production of seed in some provinces like the North-West Frontier Province and the Punjab, and

(2) the difficulties in some places of growing berseem successfully.

Experience shows that the success of berseem is intimately connected with early sowing and the presence of suitable bacteria in the soil to favour the growth of the crop. It is my impression that failure to get good berseem crops is largely due to not treating the seed with the proper bacterial culture before sowing. Seedsmen do not supply the necessary culture and even when they do so, they charge heavy prices. In the United Provinces, where berseem is now included in the improved rotations under the State tube-well and the canal tracts, very successful crops of berseem have been grown by treating seed (previously soaked in water) with a solution of the suitable bacterial culture and drying the resulting coated seed in shade before final sowing. The provincial mycologist supplied culture in tins suitable for an acre seed rate and the distribution of seed along with the culture and the necessary information about inoculation was so arranged that there was no difficulty in

getting berseem into the soil within September or early October.

Factors in seed production

With regard to indigenous seed production within the various provinces and states, however, there is genuine difficulty in parts of the country. The main factors that have an important bearing on seed production are :

(i) Price of green fodder at a given place. If the price is high then there is not much point in trying to grow seed as it will certainly be cheaper to buy it from outside.

(ii) Restriction of cuttings. Henderson states that in Egypt when the crop is meant for seed it is neither cut nor grazed after March. The general custom has been to take as many cuttings of green fodder as possible and then leave the crop for seeding. This is unsatisfactory. Seed plots must be earmarked and left alone after one or two cuttings.

(iii) Perhaps a thin stand. Seed plots must have a thinner seed rate compared to fodder plots. The amount of water should also be reduced much below that allowed to the fodder crop.

(iv) Possibility of there being special insects concerned with the pollination of this crop. This biological factor is being studied at the Imperial Agricultural Research Institute, and the Imperial Council of Agricultural Research has requested the provinces and states to send insect samples to the Institute.

Reading list

Those interested in the subject may refer to the following literature which gives useful information on the various aspects of berseem cultivation :

A summary of the important results arrived at or indicated by the Agricultural Stations in the United Provinces during the year 1932-33.

Wright, N. C.—*Report on the Development of the Cattle and Dairy Industries of India.* 1937. Pp. 60-1, 76.

Russell, Sir E. J.—*Report on the Work of the Imperial Council of Agricultural Research in applying Science to Crop Production in India.* 1937. Pp. 43, 138, 139.

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Mann, H. H.—*Fodder Crops of Western India.* 1920. Bombay Department of Agriculture Bulletin No. 100. Pp. 177-87.

Marriott, Capt. A. S.—'Notes on the Cultivation of Berseem'. 1915. *Agricultural Journal of India.* Vol. X, No. 1. Pp. 81-5.

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Zemach, S.—'Der alexandrinische Klee (*Trifolium alexandrinum*) in Palastina.' 1913. *Der Tropenpflanzer,* Vol. XXXIV. Pp. 315-40.

Todaro, F.—'Distinction of *Trifolium incarnatum* and *T. alexandrinum* seed in mixtures'. 1935. *Herbage Abstracts,* Vol. V. P. 105.

Malinkin, N. P. and Pozariiskaja, L. P.—'Lucerne, forage crops and annual legumes under dry farming conditions'. *Herbage Abstracts,* Vol. V. 1935. Pp. 210-11.

Mostovoj, K. and Zaitschek, D. V.—Laboratory testing of varietal differences in *Trifolium alexandrinum*' (in Russian). 1938. *Herbage Abstracts,* Vol. VIII. P. 156.

Kennedy, P. B. and Mackie, W. W.—*Berseem or Egyptian Clover* (*Trifolium alexandrinum*). 1925. University of California, College of Agriculture, Agricultural Experimental Station, Berkeley, California, Bulletin No. 389.

'Egyptian Clover Seed'. 1916. *Agricultural Gazette of New South Wales,* Vol. XXVII. P. 408.

ABORTION AND CALCIUM DEFICIENCY IN EQUINES

By V. R. Rajagopalan, G.M.V.C., Dip. Bact. (Manc.)
Imperial Veterinary Research Institute, Mukteswar, U. P.

For the maintenance of health, animals require fresh air, pure water and wholesome food. Wholesome food, in modern times, implies food that is not only fresh and palatable but also of the right quality. A good quality food should contain correct proportions of proteins, carbohydrates and fats in digestible form, as well as an adequate quantity of properly balanced minerals and of those agents known as vitamins which, in some mysterious manner, control the mobilization of certain elements in the body and prevent a number of diseases of nutritional origin.

The writer proposes to describe briefly his personal observations upon one small aspect of this great problem of nutrition—that of the predisposing of mares to abortion by a deficiency of calcium in their feed. In doing so, however, it should be emphasized that calcium is not the only mineral that is required for the normal termination of pregnancy. It is only one of several minerals which together establish the equilibrium necessary for the normal functioning of the body. A pregnant animal requires not only all the minerals that a normal animal needs, but also some of these in excess of normal requirements to provide for the formation of the foetus. In order, therefore, to present the matter in its proper perspective, a short description of the function of minerals in the normal animal body is desirable.

Essential elements

Among the elements essential for life, minerals should perhaps be ranked as second in importance only to air and water. For whereas a man could live for a number of days on mineral water alone, he could survive for only a very short time if fed upon food devoid of all trace of minerals. Minerals are found in all the vital parts of the body and they appear to exercise a direct influence over all the processes of life. The animal body is composed of multitudes of microscopic living units called cells. Each of these cells contains a nucleus which controls the activities of the cell in the same way as the brain controls the activities of the body. An indispensable element of the brain itself, as well as of the nuclei, is phosphorus. Iron, meanwhile, is part of the make-up of haemoglobin, a substance which imparts the red colour to our blood. This haemoglobin transports oxygen from the air in the lungs to the tissue cells all over the body. Without oxygen the cells cannot live and function, and thus iron is concerned in the transformation of breath into life. The physical state, which is necessary for the transport of nutrients and waste products through the cells, is established by the presence of several mineral salts. Again, the intestinal ferments which break down food into assimilable products act only in the presence of acids or alkalies which are formed from the mineral matter of the blood. Calcium and phosphorus are the main components of the skeleton, the bony framework which supports the soft parts of the body, protects its delicate tissues and acts as a system of levers for the performance of work.

Mineral deficiency and disease

The above are but a few examples to illustrate the vital functions played by minerals in the body. Some of the minerals which have thus been shown to be essential for the normal upkeep of health are sodium, chlorine, calcium, phosphorus, iron, iodine, copper, sulphur, potassium, magnesium, manganese, zinc, cobalt and fluorine. A deficiency of any one of these minerals in the body will lead to a particular 'deficiency' disease. Thus a deficiency of sodium chloride causes a

loss of appetite and consequent emaciation ; a deficiency of calcium, phosphorus, or vitamin D leads to the disease known as rickets or osteoporosis ; of iodine to goitre, hairlessness, or a bloated condition at birth ; of iron or copper to anaemia ; of magnesium to irritability, convulsions and death ; of manganese to stunted growth and lessened reproductive powers ; of zinc also, to diminished growth and reduced hair production ; of cobalt to a deficiency disease known as 'bush-sickness' ; and of fluorine to under-development of the enamel of the teeth. Some of these minerals, such as copper and fluorine, are violent poisons when taken in large quantities, yet traces of these are indispensable for the maintenance of health. To avoid disease, not only are all these minerals necessary in the feed but they must be supplied in a correct proportion. For instance, if too much of phosphorus is supplied, it will reduce the amount of calcium that can be assimilated, and *vice versa*.

Nutritional abortion

A pregnant animal should be maintained in good health. It should therefore receive adequate quantities of all the essential minerals. In addition, it should be supplied with a larger quantity of certain minerals in order that the body of the foetus may be built up. Several observations have been made in experimental institutions in Great Britain and the United States upon such animals as the ewes, sows and cows as regards reproductive disorders consequent upon feeding with inadequate quantities of certain minerals. Thus on a calcium-deficient diet the number of pigs born dead was observed to increase from 4·8 per cent to 50 per cent within four successive farrowings. If the deficiency was not acute, live pigs were frequently born but the litters were usually sickly and there was a heavy mortality after birth. Similar observations have been made on cows. Cows fed on single fodder plants, e.g. oats, wheat or maize, produced extremely poor calves which were either born dead or died shortly after birth. The addition of calcium and butter to the oat ration or of calcium, cod-liver oil and salts to the wheat ration led to normal reproduction. Ewes have also been shown to be unable to complete a normal pregnancy on a calcium-deficient diet.

Deficiency in phosphorus also appears to upset normal calving. In South Africa among cows confined to veldt grazing, 80 per cent of those receiving a phosphate supplement calved normally as compared with only 51 per cent of the controls.

Deficiency in iodine in the mother has been known to cause losses among new-born pigs, lambs, kids, calves and foals. These are born dead, or weak and goitrous, the losses being specially severe in the case of pigs and lambs. Foals born of iodine-deficient mares are weak at birth and frequently succumb to navel-ill and pneumonia. Manganese is also believed to be essential for normal reproduction.

Pregnant animals in nature instinctively acquire special tastes for food containing the minerals or other nutrients necessary for their health. They are inclined to lick rocks, chew bones or eat garbage. Under domestic conditions, it is the breeder's duty to see that his animals are raised on proper soil and provided with feed of the proper quality.

Requirements of the pregnant mare

While numerous observations, such as the above, are on record regarding the mineral requirements of pregnant ewes, sows and cows, very few observations have been made on the mineral requirements of the pregnant mare. In spite of the fact that large numbers of mares are bred for the provision of army remounts, for racing, sport and transport labour, surprisingly little attention has been paid to this important aspect of their nutrition. It is logical to consider that the mare should receive sufficient protein of good quality and enough calcium and phosphorus to provide for the building-up of the protein tissues and the skeleton of the foal, and all the other minerals in quantities sufficient for providing for the normal health of the mare and the foetus. Moreover, as a new-born foal subsists on its dam's milk during the first few weeks after birth, it has to depend upon this for the supply of the necessary minerals and other nutrients. Normal milk usually contains adequate quantities of calcium and phosphorus

for the needs of the new-born, but it contains scarcely any of the other essential minerals. Hence nature provides that the young are born with a sufficient reserve of all the essential minerals to last until they are able to assimilate their own supply of minerals from other sources than milk. Since the mare's milk is relatively poor in calcium and phosphorus, the need for the mare to build up extra reserves for its foetus may be readily appreciated. But it is often unfortunately presumed that the mare can pick up sufficient minerals for all these purposes from the liberal supplies of concentrates and roughages with which they are usually provided. This, however, is not always the case and an example of what may happen, when the mare's feed is deficient in these, follows.

Abortion and calcium deficiency

This was noted to occur on a Government stud farm where cost is subordinated to efficiency. Pregnant mares on the farm were being fed with the following ration :

Gram	2 lb.
Bran	3 lb.
Barley	4 lb.
Oats	2 lb.
Salt	2 oz.
Hay	10 lb.
Lucerne	15 lb.
Kadbi	5 lb.

It appears from this ration card that the two minerals, calcium and phosphorus that are required in greater quantities at pregnancy were available in adequate quantities from the lucerne and concentrates respectively. Yet, abortion occurred among the mares and assumed widespread proportions, the cause, as shown below, being finally assigned to calcium deficiency. The abortions occurred early in 1936, in such rapid succession that an outbreak was suspected. Accordingly, blood samples from all the mares were collected and tested for evidence of infection with the germ which commonly causes contagious equine abortion. At the same time, the foetal membranes and the aborted foetuses were examined bacteriologically for these germs. These examinations showed that the abortions were not caused by germs, but an examination of the feeding history revealed a peculiar relationship between mineral feeding and the cessation of abortion. The normal rate of abortion in the stud prior to 1929 was about four to seven per year and the foals that were born were weak and liable to diarrhoea. In 1929 the authorities introduced the 'Churn' brand of mineral flour with a view to increasing the bone measurements of their young stock. This product is issued by Imperial Chemical Industries, Ltd., and contains iron, calcium, sodium chloride, phosphorus, sulphur, potassium and iodine. During 1930 the abortions were reduced to two. During 1931, 1932, and 1933 there were no abortions and in 1934 there was one. This mineral supplement was stopped in 1934. In 1935 there were two abortions and in 1936 twelve abortions up to the month of May.

Cause established

The introduction and withdrawal of mineral supplements in this stud coincided with the disappearance and reappearance respectively of abortions. Blood was therefore collected for mineral estimation and calcium deficiency was detected. Whereas the normal calcium content of the blood of mares should be from 10 to 15 mgm. per cent, the calcium level of the blood of the mares in this stud ranged in most cases from 7·7 to 8·7 mgm. per cent. The mineral flour was immediately reintroduced (i.e. in May, 1936) and there were no more cases of such abortion in the stud. About one year and nine months after the reintroduction of the mineral flour an estimation was again made of the mineral contents of the blood of the mares involved. This time the calcium level was found to have increased to between 13·0 and 15·4 mgm. per cent that is within the normal range.

A critical examination of the facts presented will reveal that abortions do not follow immediately after the withholding of the mineral supplements. It would appear that for some time after the cessation of the mineral supplements animals are able to absorb more fully than before what little mineral matter may be available in their ordinary food, making up deficiencies by releasing minerals from their own structural make-up. Thus the

pregnant animal may complete one or two pregnancies, although the young thus produced are born weak and susceptible to disease. But soon a stage is reached when the animal can no longer spare any more minerals from its body without a serious breakdown. It is then that abortions occur in rapid succession. On the other hand, the introduction of mineral supplements speedily seems to exert its beneficial influence. Actually most pregnant animals, which are otherwise well-fed, may be induced to complete a successful pregnancy by offering mineral supplements during the last third of pregnancy, the period during which most rapid foetal development takes place.

A NEW HEAVY-YIELDING VARIETY OF SUGARCANE

By Ch. Khushi Mohammad, B.Sc. (Agr.), Assoc. I.A.R.I.

Sugarcane Research Station, Jullundur

AMONGST the sugarcane varieties now recommended to the zemindars by the Department of Agriculture, Punjab, Co 312 undoubtedly is the heaviest yielder, but unfortunately it suffers from the following two very serious defects :

1. It has a habit of lodging and this defect is very pronounced on rich soils ; its yield, therefore, under such conditions is adversely affected. Apart from the commonly known fact that a lodged crop gives poor quality of produce, rats and other wild animals also play havoc with it. The buds begin to sprout very early in the season and become unfit for seed purposes. This variety, therefore, though quite good for average or poor soils has proved to be quite unsuitable for good conditions of soil or cultivation.

2. It is very susceptible to the attack of pyrilla and in bad pyrilla years, the quality of its produce and the yields are very poor.

Merits of new variety

It is gratifying to bring to the notice of the zemindars that a new variety of sugarcane (Co 421) is quite as heavy a yielder as Co 312 and has the additional advantage of freedom from the above two defects. The results of the trials with this variety, conducted at the Sugarcane Research Station, Jullundur, are summarized in this article.

This variety was originally received at this station in February 1934 and has been under very close observation since then. The yields of this variety along with those of Co 285 and Co 312 are given in the following table :

Year	Variety	Yield of stripped cane per acre (Maunds)	Yield of *gur* per acre (Maunds)	Percentage of *gur* to cane
1936-37	Co 285	1,270·7	125·8	9·9
	Co 421	1,355·4	136·9	10·1
1937-38	Co 285	857·75	85·0	9·9
	Co 421	1,003·5	101·0	10·06
1938-39	Co 285	1,149·8	107·6	9·35
	Co 421	1,239·8	117·8	9·50
	Co 312	1,274·6	96·0	7·53
1939-40	Co 285	1,089·2	116·6	10·7
	Co 421	1,284·6	144·4	11·24
	Co 312	1,323·0	140·8	10·64

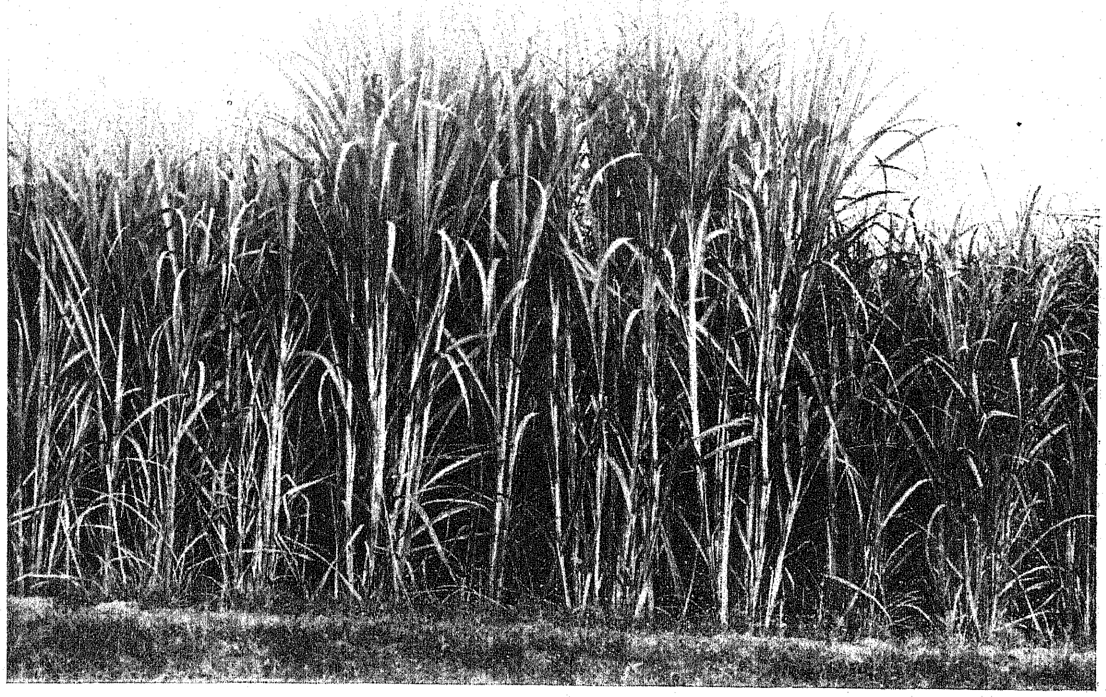
It is quite apparent from the above data that—

1. Co 421 is a much higher yielder than Co 285—at present the most widely grown variety in the Punjab. The average *gur* yields of Co 285 and Co 421 during all the four years are :

	Maunds
Co 285	108·75
Co 421	125·03

On an average, Co 421 has given 15 per cent higher yield than Co 285 ; the former variety has thus fully established its superiority over Co 285 in yield.

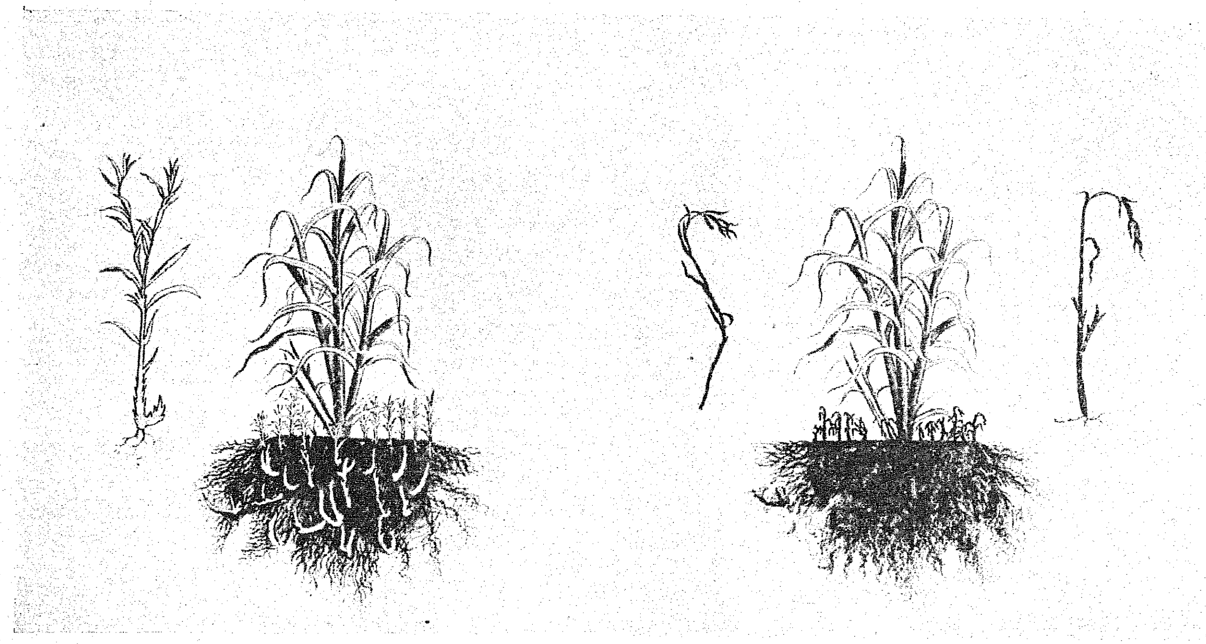
2. In 1938-39 and 1939-40, the yields of stripped cane of Co 312 are higher than those of Co 421, but in *gur* yields the case is quite the reverse. The difference in their *gur* yields in 1939-40 is not so great, i.e. only 2·5 per cent, but in 1938-39 it is as high as 22·7 per cent The reason for this apparently strange



Co 421 standing shoulders high above other varieties in a cultivator's field.

Co 312 (centre) had to be cocked when it had lodged badly after a heavy storm.
Co 421 (on both sides) did not suffer under those conditions.

STRIGA CONTROL



Before treatment After treatment

behaviour of Co 312 lies in the fact that 1938-39 happened to be a bad pyrilla year and this variety, due to its greater susceptibility, was very badly attacked. Consequently, its juice remained very poor and the percentage of *gur* to cane remained as low as 7·53 as against 9 50 of Co 421.

The year 1939-40 was practically pyrilla-free and the difference in the yields of Co 312 and Co 421 is not very marked, though even here the percentage of *gur* to cane in Co 421 is higher than that in Co 312.

The above facts have conclusively proved that Co 421 is a much safer cane to grow than Co 312, especially in tracts where pyrilla is a serious pest.

3. The juice of Co 421 contains greater amount of total solids than Co 285 or Co 312 and the percentages of *gur* to cane in Co 421 are always higher than those in Co 285 and Co 312.

Other characters of Co 421

Germination and growth.—It is vigorous in germination and its mode of growth attracts attention from the very start. It grows erect and does not lodge. It is a tall-growing variety, being taller than Co 285 and Co 312 at all stages of growth. It possesses a very good root system.

Time of maturity.—The results of the chemical analysis have shown that it ripens at about the same time as Co 285 and Co 312: under good conditions, it will mature in the second fortnight of January in the Punjab.

Resistance to wild animals and rats.—It has a harder rind than Co 312 and is, therefore, not damaged much by rats and wild animals, wherever they are serious.

Quality of gur.—It is commonly known that the *gur* of Co 285 has got a reddish tinge, which is generally not liked by the consumers; *gur* of Co 421, on the other hand, is free from this defect.

From the above account, it is apparent, that for those zemindars who have good conditions at their command, this new variety of sugarcane will be the most profitable to grow. The seed of this variety was given to a few selected persons in the Nawanshehr tehsil of Jullundur district, and the zemindars in that *illaqa* were so much impressed with its performance that there was a huge demand for its seed. Some of the zemindars were able to sell its seed at Rs. 80 per *kanal*, or Rs. 800 per acre.

During the current year, arrangements have been made by the Deputy Director of Agriculture, Jullundur, for the multiplication of the seed of this variety and large quantities of it will be distributed amongst the sugarcane growers in March, 1941.

What the Scientists are doing

STRIGA CONTROL

LIKE most crops, the sugarcane has a large number of enemies to contend with during its growth in the field. These include the roaming elephant, the artful monkey, the cunning jackal, rats, borers, pyrilla and white ants from the animal kingdom and fungoid and other diseases like red-rot, smut and mosaic.

Yet another foe of comparative minor importance lurks in the flowering plant, *striga*, species of which have been known to attack also other food crops like *jowar* (*Sorghum*), maize (*Zea mays*), Finger millet (*Eleusine coracana*), paddy (*Oriza sativa*) and *bajri* (*Pennisetum typhoideum*). The plant has many Indian names, and one of these—the Tamil name *Sudumalli* or the burning scourge—aptly describes the effect of the attack which causes a dried, burnt appearance.

How the parasite lives

This is a soft-stemmed whitish plant growing to about three feet in height with small white flowers that turn blue when dry. It has small green leaves and is a semi-parasite, i.e. while it can elaborate food from its own roots and leaves, it also possesses an efficient mechanism by which it can draw a great deal of nourishment from its hosts. This is done by the roots of this plant developing on those of the hosts small cup-shaped structures called haustoria. These establish a direct connection between the vascular or food-intake system of the host and of the parasite. The food material passing up the roots of the sugarcane is thus tapped half way for the benefit of this parasite. The plant produces large numbers of tiny light seeds, not unlike dust particles, which are credited with possessing a long viable period placed by some authorities at over 20 years. These seeds lie dormant in the soil till the proper hosts are available, when they germinate freely and the plants flourish mainly at the expense of the hosts.

The method of control of the weed is based on a knowledge of its life-history and attacking it at its weakest or most vulnerable phase. This is the vegetative stage when the comparative soft plants are readily killed by solutions of copper sulphate 2 to 3 per cent. Care has to be taken to see that the whole plant (including the underground portion) is killed, as otherwise the latter produces a profusion of tillers distinctly worsening the situation. The application of copper sulphate solution is best done by forming a cup-shaped depression in the soil round the plant, and filling it with the solution till it soaks to the base level of the underground shoots of the plant which is generally about 4 to 6 in. While a 2 per cent strength is enough, a 3 per cent solution is safer to use and this strength has no evil effects on sugarcane. It is interesting to mention that copper sulphate has not only no evil effects on the soil but under certain condition (e.g. the peat or muck soils of Florida) marked beneficial effects on cane growth have been obtained with a dressing of up to 75 lb. of the sulphate to the acre. When a sugarcane clump is heavily attacked, as in the illustration (Plate 36), the earthen depression needs to be made round the whole clump and filled in with the solution.

Effective method of control

Removal of the plants by hand is of little use, as the plants are brittle and the portions left in the ground quickly develop side-shoots. The same thing happens when the solution does not effectively reach the underground portions of the plant. It is useful to mark with stakes or twigs spots where *striga* had appeared in the field and watch and treat with the solution any plants that may develop. The parasite grows very quickly, develops fruits and seeds even when young, and produces an abundance of tiny light seeds all of which help to multiply the parasite rapidly. A constant watch needs to be kept on the infected fields to prevent any of them coming to seed as even a few such would entirely nullify the whole

control work of the season. When carefully done, the method is very effective. A field at the Coimbatore Sugarcane Station which was very heavily attacked through seeds borne by flood water from a neighbouring *jowar* field was successfully rid of the parasite in two years. The method depends on growing the needed hosts to germinate the dormant *striga* seeds and destroying the comparatively soft plants in their vegetative stage. Success of this method depends entirely on day-to-day vigilance in the field, but it is certain in results.

* * *

PADEGAON SUGARCANE RESEARCH

SINCE 1932, a closely coordinated plan of research on sugarcane has been in operation at Padegaon. The soil section has classified soils of the tract and has studied soil changes under cane-growing from the point of view of their management, including the deep soils (among these being the *chopan* or alkali soils) which were considered as unfit for irrigation. The physiology section has carried out investigations on the physiological responses of the crop to climate, water and manure. Finally, large-scale experiments based on these findings and also critical trials of a number of sugarcane varieties for adoption in the canal areas have been conducted on modern statistical lines by the agricultural management section. A large amount of information is thus available which is capable of being used to increase the level of efficiency of sugarcane production in the Bombay Deccan, and a good deal of this, dealing with certain aspects of sugarcane growing, has already been given out in the form of the following departmental publications.

Leaflet No. 6 of 1938.—*A summary of practical results of sugarcane research in the Bombay Province (1932-37).*

Leaflet No. 1 of 1939.—*Preparation of compost from cane trash.*

Leaflet No. 1 of 1940.—*Work on heavy* (chopan) *soils of the canal tracts of the Bombay Deccan.*

Leaflet No. 2 of 1940.—*A popular note on the soils of the Deccan canal tracts, Bombay Province.*

Leaflet No. 3 of 1940.—*Promising sugarcane varieties for cultivation in the Deccan canal tracts, Bombay Province.*

Leaflet No. 4 of 1940.—*Planting of sugarcane—suggested improvements in methods and proper selection of planting material with the object of ensuring maximum germination.*

However, the applicability of the results of the Padegaon farm to other places, with the degree of precision which would be demanded from the point of view of scientific and business-like methods of cane cultivation, is faced with two main difficulties. In the first instance, soil types differ considerably from place to place, and secondly, variations in the climate introduce far-reaching differences in the physiological responses of the crop. The necessity, therefore, arises of two things, one of conducting the experiments on all the soil types under the same climatic condition, and the other of repeating the experiments on the different types in the environmental conditions under which they naturally occur.

The first part of this work has already been in progress at the farm on the important soil types which are differentiated according to the genetic system of soil classification and which have been taken up for experiments in cane-growing. But due to obvious limitations these investigations have to be restricted to small-scale experiments in pots, or lysimeters (i.e. square cement tanks each of 1/1,000 acre in area). The repetition of the Padegaon experiments on a field scale under different environmental conditions was a greatly felt want and recently a scheme has been sanctioned by the Government of India financed from the Sugar Excise Fund for the establishment of sub-stations situated on soil types in representative canal areas. Four such sub-stations have been started in July on the following places: (1) Hol (*C* type)—Nira Left Bank Canal, (2) Akluj (*D* type)—Nira Right Bank Canal, (3) Deolali (*G* type)—Pravara Right Bank Canal and (4) Lakhmapur (*F* type)—Girna Canal. In addition to these, part of Kopergaon farm of the Bombay Government on the Godavari Left Bank Canal will be used

for work on the *A* type of soil. The Padegaon farm is situated on the *B* type of soil.

Soil survey and soil mapping

In order that farmers and planters may derive the fullest advantage of the specific methods of cane-growing and soil management that are being evolved for each soil type as described above, it would be necessary to carry out a soil survey of the tract and prepare soil maps in which all the necessary information required by an average intelligent cane-grower may be represented to enable him to plan a sound scheme of cropping and manuring for his land.

The method by which the soils of the tract have been now classified is known as the genetic method and is the modern and universally accepted system. It takes into account not only the properties of the surface soil but the whole succession of layers down to the parent material, called the soil profile, which is thus the unit of study in this method. The technique of soil examination consists of the examination of profiles in the field (which have to be exposed by digging pits), supplemented by a number of chemical analyses in the laboratory. The method, while useful for the identification of soil types, is a little elaborate, and a large-scale survey on these lines would be laborious and expensive. Hence it is considered essential to simplify it without in any way impairing its precision. For this purpose a scheme financed from the Sugar Excise Fund has been recently sanctioned by the Government of India for an experimental survey and mapping of an area of 1,000 acres of land. Two blocks of 500 acres each, one of shallow soil and the other of deep soil, have been taken up for this work in the estates of the Belapur Sugar Co. at Harigaon and Messrs Marsland Price & Co. at Kalamb, respectively. The work has been started and has been in progress since July. It is proposed to complete it within two years.

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CLEANING DAIRY UTENSILS

THE use of washing powders in cleaning dairy utensils is practically unknown in India. The current practice is to scour utensils with wood ash or fine mud, wash them with clean water and expose them to strong sunlight, or in wet weather invert them over an open fire. The practice is not worthless: its effect lies in the abrasive and chemical action of mud and ash and in the bactericidal action of sunlight or heat.

The apparent primitiveness of the method, however, casts doubt on its efficiency, and to determine the efficiency of this method in comparison with western practices an investigation was undertaken by H. C. Verma, D. L. Paul and Z. R. Kothavalla at the Imperial Dairy Institute, Bangalore, on the detergent efficiency of soda ash, wood ash and mud on brass and tinned steel milk utensils.

All the utensils were first contaminated with milk which was allowed to curdle in them. One set was cleaned with ordinary water and the others with the respective cleansing agents. All the utensils were then exposed to the sun for 30 minutes. Bacterial counts and presumptive coliform tests were made in all cases. Each cleaning treatment was repeated 20 times. The results show that soda ash has the highest cleansing efficiency, wood ash makes a very near approach to soda ash, and mud comes last of all. The investigation is not claimed to be exhaustive and complete, but it illustrates the detergent efficiency of wood ash and mud in the rural practice of cleaning milk utensils.

What would you like to know ?

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section will be reserved for replies to selected letters in cases where it seems that the information might be of general interest.

Q : Please tell me how to make naphthalene acetic acid and indolebutyric acid. Are they used as fertilizers or not ?

A : Napthalene acetic acid and indolebutyric acid are the most important of the known growth-promoting chemical substances which behave like plant-hormones. As they are the most effective root-forming substances yet discovered, they are capable of being used for practical plant propagation. They are never used as fertilizers. Their preparation is rather complicated and may be possible in a well-organized chemical laboratory dealing with the synthesis of complex organic compounds.

***

Q : (1) What are the maximum and minimum temperatures under which potatoes are stored ?

(2) What are the variations of temperature required for different varieties of potatoes and different months of the year ?

(3) What should be the humidity of the storage room ?

(4) How should the potatoes be packed for storage ?

(5) How many potatoes can be stored in one cubic foot of space and what should be the space for ventilation ?

A : (1) The maximum and minimum temperatures under which potatoes are stored are 40° and 35°F. respectively.

(2) No information regarding different important varieties of potatoes grown in India is available. Only the Italian white round variety in cultivation in the Bombay province has been tried in detail in cold-storage.

(3) The humidity of the cold store should generally be between 80 and 90 per cent.

(4) It is better to keep potatoes in cold storage loose in bins about 4 ft. high. This has not, however, been tried.

(5) Roughly 20 seers of potatoes could be stored in one cubic foot space. As regards space for ventilation we have not made any experiments of our own. But it would be sufficient if enough space is left between the rows of bins so that the workers could easily move about to examine the potatoes, etc.

***

Q : I hear *Bara* rice sells in Delhi at a higher price than Dehra Dun *Basumati* rice. I wish to cultivate a portion of my plot in the Trichy district with this paddy. I have water throughout the year except from May 15 to June 20th. If it is not a flowering season-bound variety but a duration-fixed variety capable of yielding in any part of the year I want to sow it before the first of January.

A : *Bara* rice is grown near Kabul and it is difficult to obtain its seed. Another type, similar to it but probably of a poorer quality, is grown in Peshawar and the Punjab. Samples of this rice were once obtained from Peshawar and tried out at Nagina in the United Provinces but no special feature was, however, noticed about this rice. It was a season-bound variety like so many others, was sown in the nursery in June by the first fall of the rains, transplanted in July and harvested by about October like other common types. The yield at Nagina was about 18 to 20 md. to the acre. Not being superior to other available types, it was discarded. You had better obtain first a small quantity of seed of this type for trial either from the Director of Agriculture, Punjab, Lahore, or the Agricultural

Officer, North-West Frontier Province, Peshawar, before you sow the variety on a large scale.

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Q: What are the usual host trees for the lac insect?

A: The trees on which the lac insects thrive are called host trees. The lac insect can only lead a healthy life on certain trees in particular localities. The number of host trees is very large but it is especially grown on *ber* (*Zizyphus jujuba*), *palas* (*Butea frondosa*) and *kusum* (*Schleichera trijuga*). It grows well on *ghont* (*Zizyphus xylopyra*) in the Central Provinces, and *arhar* (*Cajanus indicus*) *bolmengo* (*Grewia multiflora*) and *gangma* (*Leea crispa*) are good hosts in Assam, *babul* (*Acacia arabica*) is a good host in Sind and *jalla* (*Shorea talura*) in Mysore.

What's doing in All-India

INDIAN CENTRAL COTTON COMMITTEE

By W. Burns, C.I.E., D.Sc., I.A.S.
Agricultural Commissioner with the Government of India

THE Indian Central Cotton Committee held its 43rd meeting on January 17-18, 1941 under the chairmanship of its President, Mr P. M. Kharegat, C.I.E., I.C.S. Following the usual practice, this meeting had been preceded by meetings of the following Sub-Committees :

The Agricultural Research Sub-Committee,
The Technological Research Sub-Committee,
The Wider Markets Sub-Committee,
The Cotton Forecast Sub-Committee, and
The Cotton Ginning and Pressing Factories Sub-Committee.

Again, following the usual practice, the Agricultural Research Sub-Committee met on two days in the first of which the 37 items on its programme were divided up amongst three smaller committees (i.e. groups of its own members) whose recommendations were considered on the second day by the full Sub-Committee. The findings of all these sub-committees were reviewed as usual by the full Committee which also considered the report of the Standing Finance Sub-Committee, the report of the Local Sub-Committee and the proceedings of the two Provincial Cotton Committees (Sind and Bengal). This system, which has now been established for a number of years, subjects every recommendation to Committee's criticism at least twice and gives every member an opportunity to express an opinion thereon. The result has been highly satisfactory. In spite of the large amount of business (a total of 75 items), it was possible to complete the work of the main Committee at 1.15 p.m. on the second day.

Record of aims and results

A few of the main items of interest may be mentioned. Mr Roger Thomas (Sind) had at the January 1940 meeting raised the question of direction and guidance to cotton-breeders and suggested the recording of cotton-breeders' aims and results in certain forms. The Secretary had been requested to draw up such forms and they formed the main subjects of discussion. It was agreed, as an experimental measure, to introduce certain forms and to include in one of them information required by certain earlier resolutions of the Indian Central Cotton Committee. The re-transfer of control and supervision of the Committee's seed-distribution and extension schemes in the Bombay Province from the Rural Development to the Agricultural Department was noted with satisfaction. The Sub-Committee had also before it the annual report on the very important scheme in the Punjab dealing with the so-called 'cotton-failure'. This is the malady locally known as *tirak* in which the bolls open badly, the seed is ill-developed and the lint is scanty and poor. The work of Mr Dastur has now made it fairly clear that the underlying cause is to be found in bad soil conditions which may be either

1. Nitrogen deficiency,
2. Salinity,
3. Nitrogen deficiency in the upper soil combined with an alkali sub-soil, this last condition being the worst and is characteristic of *tirak* every year.

Climatic conditions also play a part and if they are unfavourable (i.e. such as to cause excessive loss of water to the plant) they may produce *tirak* in areas of the first two classes (i.e. nitrogen deficiency or salinity), whereas in a year of favourable climate *tirak* might not appear. Mr Dastur has also developed a method whereby from the study of the tannin

content of the leaf, he can determine whether the plant at the boll formation stage is suffering from nitrogen deficiency or not and can apply additional nitrogen. The large-scale application of suitable remedies for *tirak* is a matter of difficulty and is the next stage in the work.

Cotton pests

There were one or two progress reports dealing with insect pests. *Heliothis obsoleta*, a bollworm attacking cotton in the Central Provinces and Berar, turns out to be the same insect as the common gram caterpillar and is also identical with the American bollworm of cotton (not to be confounded with the Mexican bollweevil from which India, thanks to the precautions taken here, including fumigation, is still free). In Sind and Baluchistan, there is a black-headed cricket which moves in great armies and damages cotton very badly. A coordinated scheme for research on this pest and for dealing with it by means of trapping and poison baits in Sind and Baluchistan was sanctioned. Jassids are sucking insects which do great damage in the Punjab and Sind and a scheme for their study in Sind already in existence was extended.

Technological research

During the period 1 June to 30 November 1940, the excellent work done in the Cotton Technological Laboratory at Matunga was also reviewed. During the last six months a new and well-equipped Ginning Section has been added to the Laboratory, and investigations will soon be undertaken with a view to improving the ginning of Indian cottons. In addition, an order has been placed for a pilot plant for chemical cotton which in due course will be installed at the Laboratory. The testing work during this period had greatly increased and the samples dealt with were nearly three and a half times the number of the corresponding period of the last year. In addition, various important technological research items had been continued such as a study of the deterioration of the BD8 cotton with the passing of time, the effect of different treatments of Kier boil and bleaching on the quality of yarn spun from Indian cottons and the comparison of mill and laboratory tests. The testing house of this laboratory is now officially recognized in the same way as the Alipore and Cawnpore testing houses. There was an interesting discussion continued from previous meetings of the difference in price for feeding purposes of American and *desi* seed in the Punjab and to the work in progress to test the effect of feeding fuzzy seed on milk animals. Dr Lander, Agricultural Chemist in the Punjab, stated that fuzzy seed could be fed up to 2 lb. a day to dry heifers without ill effects. He was continuing the work on milk cows this year.

Extension of the Agmark

The Committee considered a proposal regarding the desirability of adopting a uniform procedure in the matter of layout, statistical analysis, interpretation and presentation of results of experiments carried out under the schemes of the Committee, and on the recommendations of the Agricultural Research Sub-Committee decided that the Assistant Statistician at present attached to the Cotton Genetics Research Scheme at Indore should, in future, act as the Committee's Statistician and that all experimental work of the Committee, particularly the layout of new experiments, should be carried out in collaboration with him. The Committee also considered and approved of the proposal from the Agricultural Marketing Adviser to the Government of India regarding the application of Cotton Grading and Marking Rules to Verum cotton. The Committee further expressed the view that the lead given by the provinces and states which had introduced the 'Agmark' system should be brought to the notice of other provinces with a view to the adoption by them of similar measures.

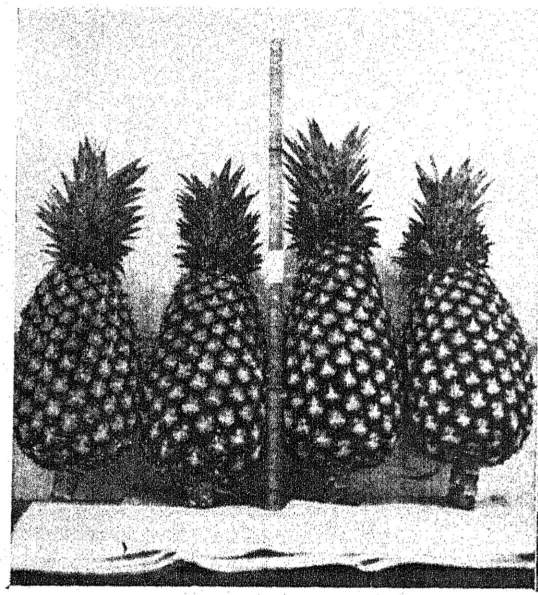
Increased consumption of cotton

In the Wider Markets Sub-Committee, Sir Chunilal Mehta introduced an important resolution requesting the Government of India in cooperation with manufacturing and trading interests to take effective measures to expand the consumption of cotton goods and cotton and woollen mixtures in this country and

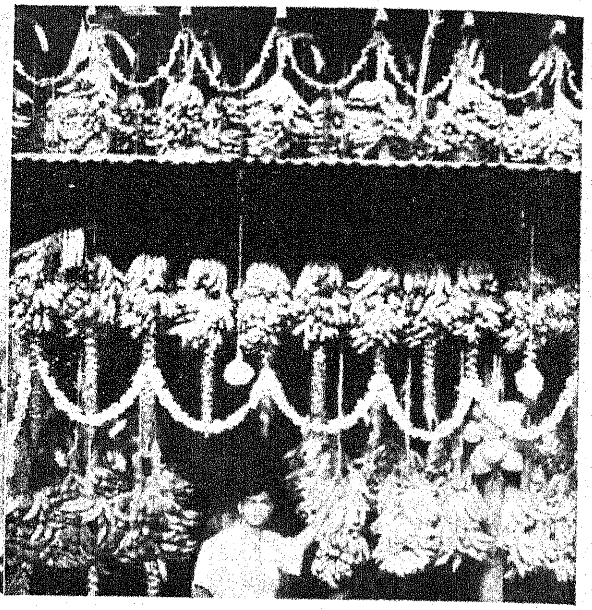
Times of India

Indian Central Cotton Committee meeting

In the photograph can be seen Mr H. R. Stewart, Mr Chunilal B. Mehta, Dr W. Burns, Sir T. Vijayaraghavacharya, Sir Chunilal V. Mehta, Mr P. M. Kharegat (President, Indian Central Cotton Committee), Mr D. N. Mahta (Secretary), Sir Shri Ram, Mr T. R. Low, Mr. Roger Thomas, Sir William Roberts and Mr R. G. Allan



Pineapples of the Giant Kew variety



Bunches of bananas exhibited for sale in a stall at Trichur

A view of a pineapple orchard at Trichur

their export overseas. This resolution was the subject later of a full-dress debate in the full meeting of the Committee at which various leaders in the cotton industry spoke and also Dr Gregory, Economic Adviser to the Government of India. As usual, the present method of cotton forecasting came in for a great deal of criticism, and it was agreed that the Director-General of Commercial Intelligence and Statistics should send up a note summarizing the present situation, its defects and possibilities.

Sir Chunilal Mehta had a tea-party for members of the Indian Central Cotton Committee at the Willingdon Club, Bombay, on January 16th, and Mr C. B. Mehta invited the members to tea at the Taj Mahal Hotel on January 17th, to meet Sir Shri Ram.

During the course of the meetings, the President congratulated Sir Sohrab Saklatwala and Sir Shri Ram on their well-deserved honours, and also mentioned the award of the M. B. E. to Mr J. Bocarro, Assistant Secretary to the Committee.

The meetings of the Committee were followed by the Second Conference of Scientific Research Workers on Cotton from all parts of India, at which 16 papers on Genetics and Plant Breeding, 12 papers on Cotton Agriculture, seven papers on Cotton Technology, one paper on Cotton Statistics and eight papers on Cotton Pests and Diseases were read and discussed.

BIHAR

By B. P. Akhaury, B.Sc. (Wales)
Deputy Director of Agriculture, Patna

There has been unusual drought and more or less complete failure of late rains, including *hathia*. This has not only affected the paddy crop, but also the subsequent *rabi* crop, which had to be grown under extremely dry conditions which are still continuing and showing their effect on the standing crop. The paddy experimental crop somehow managed to maintain a fairly uniform growth through irrigation.

The most interesting and important items of our present research programme are: (1) conduct of new factorial design cultural and manurial experiments, (2) combination of desirable economic characters of different paddy varieties into one pure strain evolved through hybridization, and (3) induced earlier flowering of different paddy varieties through 'short-day' treatment and its practical utility in artificial hybridization. All these items of research have progressed satisfactorily and show every promise of yielding useful results of great economic value.

Condition of crops

The crop of maize was just fair. Tobacco seriously suffered from leaf-curl this year. Crop of chillies is fair for the season and not very seriously affected by die-back disease as last year. Due to failure of *hathia* rains, there is general want of adequate moisture in land for the *rabi* crops and the general condition of the sown crop is not good. The failure of the rains has also badly affected the yield of paddy.

In my last report it was pointed out that after coming through a rather trying hot weather, the cane crop at the end of July was looking well up to average as the result of the favourable weather conditions prevailing during that month. These favourable conditions, however, did not prevail for long, and during the remainder of the monsoon period the rains were irregular and scanty: even the *hathia* rainfall failed completely throughout almost the whole of the cane belt, and now the condition of the cane crop is very much below average.

The restricted growth of the cane has also been accompanied by attacks of borers and fungoid diseases. Red-rot and wilt began to be evident in September mainly in Co 210 and Co 213, but this year unfortunately sporadic cases of these diseases were observed

in Co 299 as well. Smut was also in evidence in the vicinity of two factories. Ratoons of Co 210 and Co 213 are the worst to suffer in such outbreaks.

The growth of sunn-hemp as a green manure for the ensuing cane crop was not very good on account of the adverse conditions prevailing during the monsoon period. The conditions since the crop was ploughed in have been far from satisfactory as there was not enough moisture in the soil to help in the disintegration of the crop.

New resistant varieties

By far the most important development with regard to sugarcane in the province during the quarter is the release of the two mid-season varieties, Co 356 and Co 513, by the Sugarcane Varieties Advisory Committee which met in October. The Committee also recommended to the Government the necessity for drastic measures to eliminate the cultivation of Co 210 and Co 213 varieties most susceptible to red-rot. The disease position in the province, though not as bad as last year, is still of a serious nature. In several areas Co 210 and Co 213 have been completely wiped off. It is noteworthy that Co 313, in spite of its being exposed to disease during the two seasons, has not been affected at all. It has been difficult to find a single instance and the release of this variety some five years back and the trouble taken by some of the factories in multiplying it have been very helpful at a time when the major varieties were almost threatened with extinction. The condition of the sugarcane crop was below normal during the period. There was a shortage of rainfall in most of the areas.

Surplus sugarcane is a serious rural problem facing all the cane growers in Bihar.

Insect pests

(*a*) *Phthorimœa opercullela* caterpillars are a serious pest of potatoes and are doing damage in Bihar Sharif area. They are under study both in storage and field conditions.

(*b*) *Diacrisia obliqua* Wlk is pest of wide occurrence in Bihar. Its host plants are numerous: jute, peas, sunn-hemp, cabbage, *jowar*, maize, linseed, etc.

(*c*) *Agrotis Ypsilon* Rott: The caterpillars of this moth do tremendous damage to gram and other crops grown in low land or *chaur* from year to year.

(*d*) *Utetheisa pulchella* damages sunn-hemp every year.

The Entomological Section of the Department under the guidance of Dr M. L. Bhatia, the Entomologist, is at present studying the life-history and ecology of the pests with particular reference to their biological control, and it is hoped that it will be possible to control these pests.

Development work

During September to November the following grading stations were in operation:

	Sept.	Oct.	Nov.
Ghee	3	3	3
Ata	3	3	3
Eggs	..	2	2
Mangoes	1	..	..
Seed potatoes	3	3	..
	10	11	8

Of the above grading stations, those for mangoes and seed potatoes were worked as an experimental measure.

Mangoes.—The variety of mangoes selected for grading was Bathua, grown extensively round about Pusa Road in the district of Darbhanga. Grading was done under the auspices of the Mango Marketing Association, consisting of growers and dealers organized for the purpose. Approximately 123,480, Bathua mangoes were graded and packed in 859 baskets under Agmark labels during the season. These mangoes were favourably received in the Calcutta market where they fetched an average price of Rs. 4 per basket against Rs. 2-12-6 per basket of ungraded mangoes.

Seed potatoes

Of the three potato stations two were located in Patna City and one in Soh Sarai, Bihar Sharif. The three varieties of seed potatoes, namely Satha, Phulwa and Lal, were graded. At Patna City 2,412 md. were handled for grading out of which 2,391 md. were graded, while at Soh Sarai roughly 4,519 md. were handled and graded. Broadly these potatoes were

divided into three grades according to sizes which were large, medium and small. Of the total quantity graded, the quantities coming under the small were the highest, i.e. 48·16 per cent in Patna City and 44·94 per cent in Soh Sarai and those under the large were lowest, i.e. 3·93 per cent in Patna City and 14 per cent in Soh Sarai.

It will be seen that six regular grading stations worked in September while eight worked in October and November. There were three for ghee, three for *ata* and two for eggs. Besides the above, preliminary work for opening three more grading stations for ghee, two for butter, one for *gur* and two for mustard oil was in progress.

Animal husbandry

Lectures on cattle diseases and improvement of livestock were delivered in four *melas*, Bettiah, Dashara, Madhubani, Rajpur and Rajepur which were held in the Motihari circle. Magic lantern lectures were also given twice at Bettiah and once at Rajpur *mela*. Livestock were also selected at Bettiah for award of prizes. Lectures were delivered in schools and mass literacy centres to educate the students in veterinary subjects. Arrangements have been made to educate the cultivators in veterinary matters in cooperation with the District Rural Development Committees and Bettiah Raj Rural Welfare Committees.

The outbreaks of hæmorrhagic septicæmia, blackquarter and rinderpest which were prevalent in this circle during the period were promptly controlled, when necessary with preventive inoculation. Goat tissue virus vaccination against rinderpest was also done in actual outbreaks as well as in absence of outbreaks, and propaganda to impress on cultivators the utility of such vaccination was carried out.

FRUITS IN COCHIN

By M. Sankara Menon, B.A., B.Agr.
Economic Botanist, Cochin State

In the agriculture of Cochin, the cultivation of fruits occupies an important place. Out of a total cultivated area of 550,000 acres, about 40,000 acres are under fruits and vegetables. The most important fruits are the mango and the jack (*Artocarpus integrifolia*) with the banana and the pineapple occupying a conspicuous position. Of lesser importance are the papaya, the sapota or *chiku* (*Achras sapota*), citrus fruits like the pomelo, lemons and limes, the guava, rose apples and ananas.

Thriving trade in mangoes

Seedling trees of the indigenous types form the major portion of the plantings and of this, there are some excellent varieties like the Chandrakaren, highly esteemed for their sweet and juicy fruits. But of late grafted plants of choice varieties have been introduced in large numbers and there are a number of orchards of these trees. The Government Central Farm at Ollukara leads the way. It has a mango orchard of 50 acres with a stand of 2,000 trees consisting of a collection of 217 named varieties got down from different parts of India. The performance of the different varieties under Cochin conditions has been studied, and the varieties found suitable are propagated by grafting on a large scale. Thus every year over 2,000 grafts of selected varieties like the Alphonso, Natasala, Neelom, Sundersha, etc. are prepared and sold to the public. A large number of plantations big and small have grown up as a result of this and people are taking a keen interest in mango cultivation.

Cochin, like the rest of the Malabar coast, has a peculiar advantage in getting her mango fruits early in the season, and during the

months of February and March it has now-a-days become a regular custom for fruit merchants from distant places to visit these areas and purchase the fruits for despatch to the distant markets of Bombay and Calcutta. Blessed with this advantage, mango cultivation appears to have a good future before it.

Nutritious flour from bananas

Next in importance from a commercial point of view is the banana. The area under bananas in the state is 2,500 acres and the annual production is 20,000 tons of fruits. The variety grown in commercial orchards is the Nendran or Malabar banana, a variety peculiar to the west coast. The fruits are large, nine to ten inches in length, each weighing from $\frac{1}{3}$ to $\frac{1}{2}$ lb., and there are 50 to 60 fruits in a bunch. It is an important item of food of the locality, being used as a vegetable or fried as chips in oil when raw and eaten as a fruit when ripe. A highly nutritious flour is also made out of this. Cochin is having a good trade in bananas with the neighbouring districts of Malabar and Coimbatore and also with Madras.

Demand for pineapples

The pineapple is a crop which has come into prominence in recent years. There are three varieties of pineapples grown in the state, viz. the Giant Kew, the Mauritius or Queen and the local which is also called the West Indian. The Kew is the variety grown in commercial orchards and there are a number of orchards round about Trichur. The fruit is easy of cultivation, the plants being planted in rows in heavily manured trenches about six feet apart. About 4,500 to 5,000 suckers are planted per acre. The crop is ready for harvest from 18 to 24 months after planting and smaller crops are obtained during the subsequent three years also. Fruits weigh on an average 6 to 7 lb. and fruits of exceptionally big size weigh as much as 15 lb. and more. Cochin is doing an important business in pineapples, and with the recent concessions in railway freight, she has expanded her trade not only over the important consuming centres of South India, but also to such distant markets as Bombay and Calcutta.

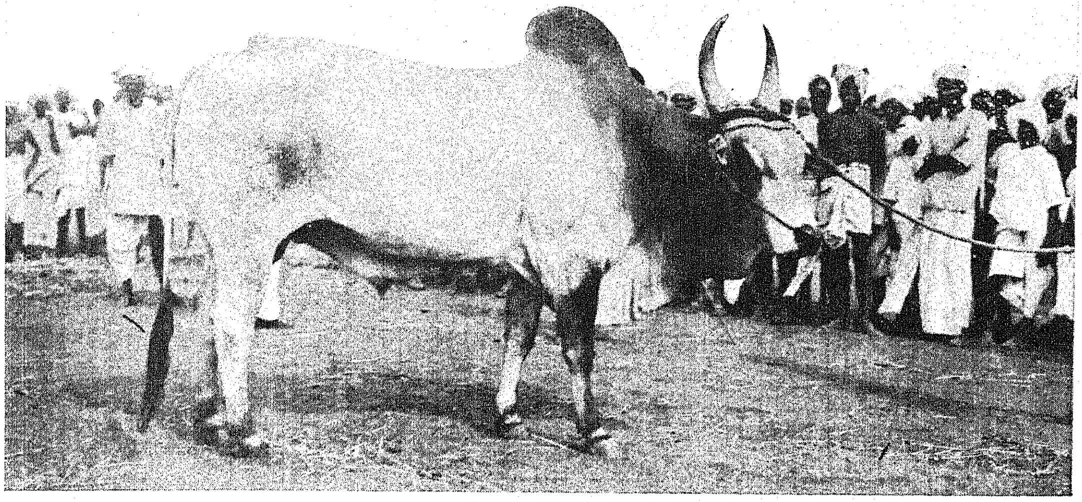
TIRUPPUR CATTLE AND PONY SHOW

THE annual Car Festival at Tiruppur is held on *Visaka Nakshatra* in the Tamil month of *Vaikasi* (May-June). At this time a very large cattle fair is held here and cattle, horses, sheep, etc. are brought to the fair for sale. Tiruppur is on the fringe of the Kangayam breeding tract proper and the majority of the cattle brought to the fair are of the Kangayam breed—the best breed of draught cattle in South India.

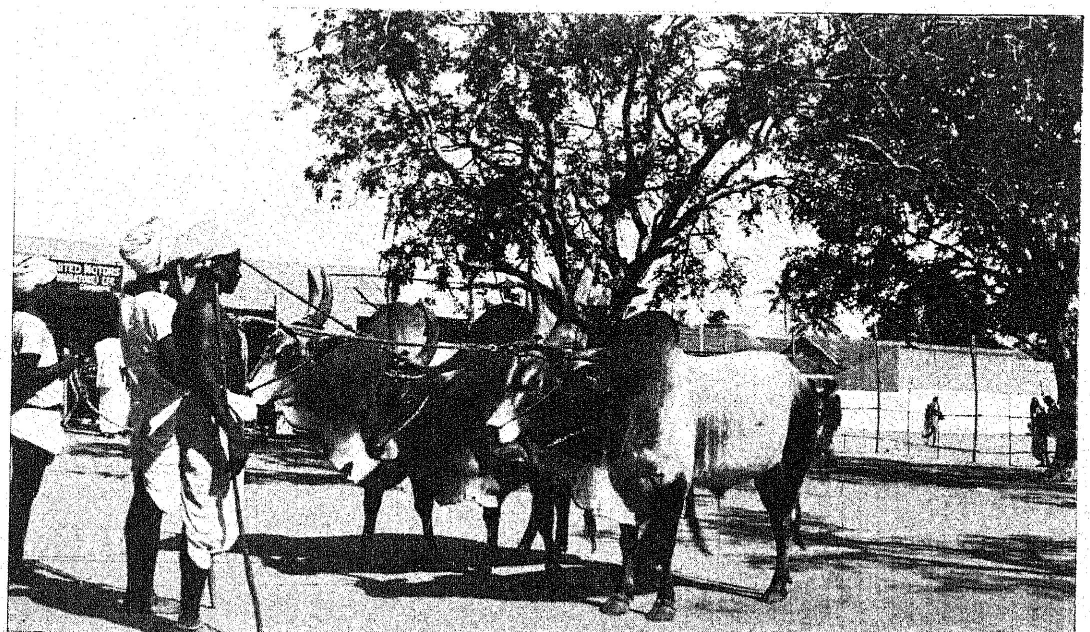
The Coimbatore District Agricultural Association organizes this cattle show at this fair every two years. Formerly the show was held annually; due to lack of funds it is now held biennially. Besides livestock, there are agricultural and industrial exhibits shown by Government Departments, private firms and cooperative and local bodies. Prizes of the value of Rs. 1,500 are awarded to the exhibitors. The chief prize-winners in cattle are the Pattagar of Palayakottai and his relatives. During the last two shows other private breeders were competing and at this year's show they were successful in obtaining some first prizes for cattle.

The 1940 show was held from 24 to 26 May and was a success. A very large number of cattle were brought to the fair and this was due to a good season and the availability of good grazing. The prices of cattle were a little higher due to the loss of cattle in the famine last year and the favourable conditions this year. The Pattagar of Palayakottai exhibited a number of ponies and some dealers from northern India also showed exhibits. There was a good demand for these but the supply was poor.

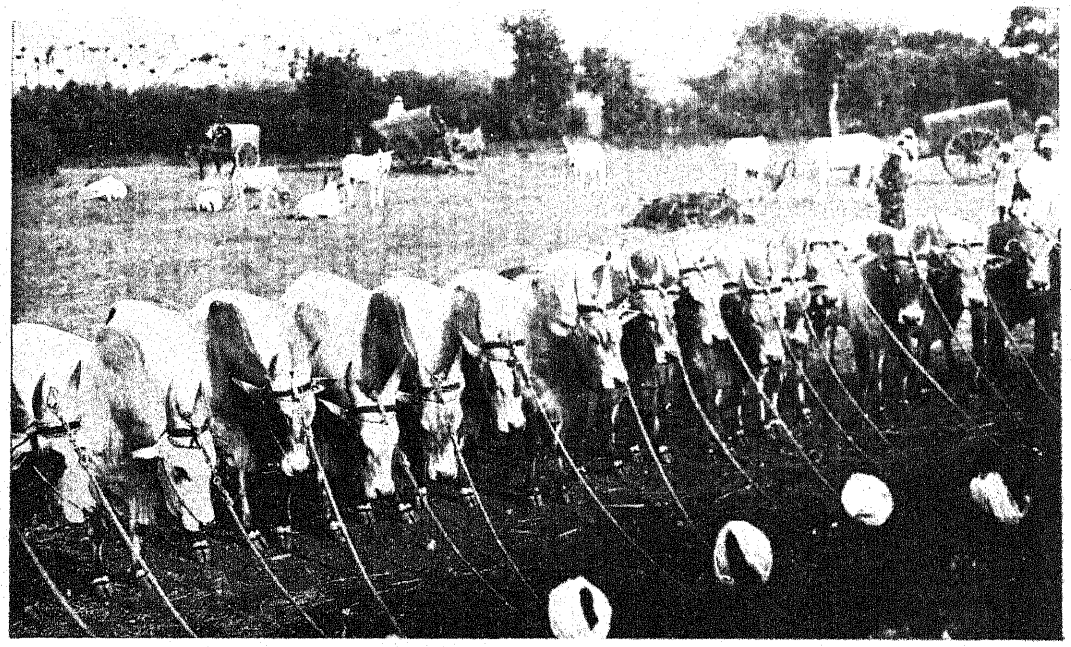
There were some very good breeding bulls



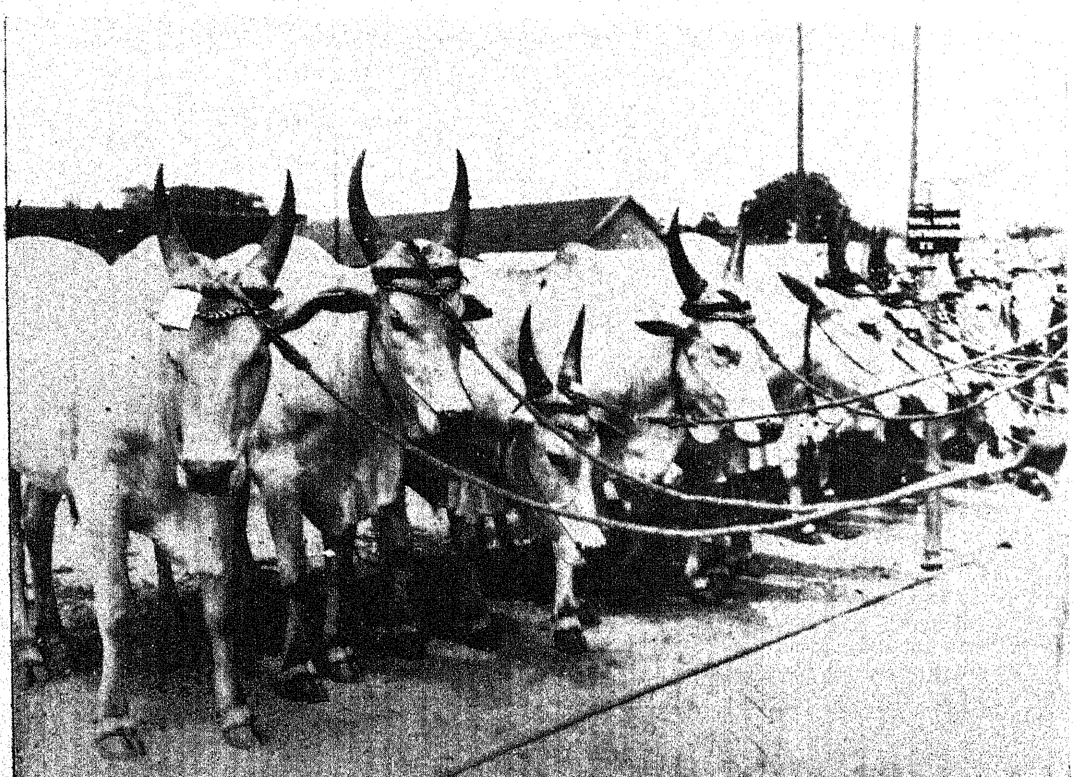
Best Kangayam bull (8 teeth)



Kangayam bulls—prize-winners



Young Kangayam breeding bulls allotted for breeding for the Coimbatore District Board Scheme



Kangayam bulls—prize-winners

exhibited in the 8, 6, 4 and 2 teeth classes. The 6 teeth class animals were excellent, and it was difficult to decide the prize-winners in the 4 and 2 teeth classes where there were 13 entries in each.

The entries of Kangayam cows were poor on the whole and this is partly due to the superstition of the evil eye on the calf.

There was a class for the bulls in the District Board contribution breeding scheme and also in the Government premium bulls scheme, and prizes were awarded for the best maintained bulls: this created a little competition.

The Agricultural Section of this year's show was not very well represented. The Agricultural Department put up a very good show which consisted of improved agricultural implements and machinery, the turmeric polisher, seeds, plants and products of improved strains of various crops, malt and malt preparations, prepared concentrated cattle feed, specimens of diseased crops, damage by insects and fungi, entomological specimens, manures and green manure seeds, beekeeping, etc.

The Agricultural Department won the gold and silver medals for the best exhibits and 26 prizes were awarded to private ryots.

The Industrial Section, on the whole, was poor. Messrs P. S. G. & Sons' Charity Industrial Institute, Peelamedu, Coimbatore, and Messrs Dandapani's Foundry Works, Pappanaikenpalayam, Coimbatore, took active part in this Section by exhibiting and demonstrating electric motors, machinery and sugarcane crushers.

The Public Health Department also took part in the show.

The Madras Government gave a grant of Rs. 100 towards prizes in lieu of the two gold medals previously awarded for the best cow and the best bull of the Kangayam breed.

The Coimbatore Sugarcane Growers' Cooperative Society offered three silver cups for the best sugarcane grown.

The show was opened by the Pattagar of Palayakottai on the 24th morning and the prizes were given away by Mr H. M. Hood, C.S.I., C.I.E., I.C.S., Second Adviser to His Excellency the Governor of Madras.

The Month's Clip

'NATURE' AND 'NURTURE'

By Alexander B. Fowler, B.Sc., Ph.D.
The Hannah Dairy Research Institute, Kirkhill, Ayr.

I FIND myself in a quandary in writing to a breeders' journal* whether to commence with breeding or feeding problems. My mind goes back, however, to my college days, to the opening lectures on Principles of Agriculture. I was impressed by the lecturer's use of the terms 'Nature' and 'Nurture'.

The more time one devotes to the intriguing study of animal breeding the greater grows the significance of these two words. To understand them properly they must be treated separately, despite the fact that they are really component parts of the same subject. The combined knowledge of both are essential to obtain results, animals of quality or a high level of production.

As an example of the influence of Nurture let us take two young animals or better still twins and rear one on a poor upland farm where the plane of nutrition is poor and food scarce. The other we will place on a good fertile farm where food is plentiful. Allow these two animals to develop and grow to maturity and note the difference. It will be found that the animal on the higher plane of nutrition will have reached maturity much sooner than the other and will be ready for production at an earlier date. This difference is accounted for by the higher plane of nutrition to which the animal was subjected during the period when growth is most rapid, namely early life.

The influence of nature can be best explained by taking two animals reared on the same farm and, to make it still more intriguing, take full sisters. Breeders do not require to be reminded that even full sisters fed and managed in the same manner often exhibit wide differences in characters. The differences in this case are due to inherited impulses for growth inherited from the parents.

From these facts, therefore, it will be seen that the breeder can never be sure of his breeding policy unless he has a sound knowledge of feeding problems. This knowledge is one of the first essentials of the progressive and constructive breeder, otherwise the potential qualities and limitations of his stock become an unknown factor. He will be unable to tell whether his stock are poor on account of his level of nutrition or as a result of his breeding policy.

Importance of herd management

The grumblings and scepticism which result from breeders who do not appreciate records at their true value and who imagine that these records are due to breeding are often heard even in these enlightened days. Lush, an American investigator, puts the influences of proper nutrition and management at 39 per cent, genetic or environmental influences at 33 per cent, genetics 26 per cent and breed 2 per cent. These figures show the importance of herd management.

This subject is so important that I intend to deal with it more fully at a later date. I have so far endeavoured to justify my decision of dealing with the subject of nutrition prior to that of breeding problems. Let us commence with the nutrition of the calf but to do this properly we must begin before the calf is born. So many calves are born weaklings due to faulty nutrition of their dams that it appears as if this phase in the calf's life-history has been sadly neglected or not properly understood. A proper foundation is essential in any structure and equally important in this instance. In order, therefore, to ensure a calf a proper start in life it is neces-

* *The Ayrshire Cattle Society's Journal*, Vol. 12, No. 1, March 1940.

sary that the dam be given proper care before and at the time of parturition. It is a good practice to have the cow dry from six to eight weeks before calving. This allows her to put on sufficient flesh to tone up her system for her subsequent lactation. It is also equally important to benefit the calf, for up to the last few months the nutrients required for the fœtus are small but during the latter end of pregnancy the calf's rapid growth requires a considerable amount of nutrients. Cows that calve without drying off generally drop weak calves, a fact which shows that the dam may not have received proper care and attention. It is sometimes noted, however, that an excessively fat cow will also drop a weak calf. The theory in such cases is that the blood is kept away from the uterus, and the fœtus, therefore, does not receive proper nourishment.

During the last week preceding calving the cow should receive laxative food so as to ensure the bowels being loose at the time of calving. Bran is an excellent ingredient in the ration at this time.

There is, however, one other aspect in the care of the dam prior to calving which is becoming increasingly apparent, namely to ensure a proper supply of vitamins. One has only to listen to the talk of woe and despair of calf rearers during the months of February, March and April to appreciate the toll, paid for this neglect, in disease and death of young calves.

Consider why this should be. Cows calving at this time have been stall-fed since Autumn and reserves in the body of vitamins stored there during the grazing season are exhausted by this time. The dam's blood stream in carrying nutrient to the fœtus should also convey a supply of essential vitamins which are stored in the calf's liver. When the calf is born these vitamins give the calf a resistance to disease but if they are not present the susceptibility of the calf to disease is greatly increased.

The chief sources of the important vitamins are green foods and unless the in-calf animal gets these foods her unborn calf is almost bound to suffer.

The details of the nutrition on farms where calf mortality is high usually confirm the fact that the cows are suffering from a lack of vitamins, especially A and D. This being so the calf's resistance to diseases such as white scour, navel ill, joint ill and calf pneumonia are slight, hence the high death rate. The unthrifty condition of many calves so commonly seen at this period of the year may also be put down to the same cause.

This problem is at present being investigated by research workers and more knowledge will undoubtedly be forthcoming.

Wherever possible cows calving in the months already mentioned should receive green foods of some kind. For example 28 or 30 lb. Marrow Stemmed Kale; 2 lb. dried grass or 10-15 lb. grass silage give good results. Properly cured green hay is better than nothing if none of the foregoing are procurable, but again how seldom does one see hay cut at the proper stage for this purpose. Roots, such as turnips and swedes, are no use as they do not contain carotene and are therefore not a source of vitamin A.

Attention to healthy calves

Let us return, however, to a more pleasant subject, the attention of the healthy calf. As soon as the calf is born it should be well dried and immediately it is able to drink it should receive its first drink of milk.

It is a mistake to wait your own convenience in completing this task as so many do. Some even wait 12 hours. The 'colostrum' or first milk has a vital duty to perform. Its special purpose is to cleanse away the metabolic products that have collected in the intestines of the calf during the latter portion of its fœtal days. The sooner this is done the better. It will be found that the calf will be willing to suck even half an hour after birth and an endeavour should be made to give it at least a pint of colostrum.

The after treatment is relatively simple provided milk is plentiful. A simple rule to follow is to increase the feed by a half pint each meal until the calf is getting 1 lb. of milk for every 10 lb. body weight.

One finds, however, that milk is usually scarcest on a dairy farm unless young bulls are reared, but I do not intend to deal with

those favoured animals. I champion the rights of the dairy heifer calf whose lot is usually so misunderstood. As McCandlish so ably put their case: 'It is all very well to rear calves cheaply, but it is false economy to stint, and consequently stunt the calves.' Need I say more ? A good start in any race is a flying start. Therefore I would recommend that for the first four weeks at least, whole milk should be fed. The young calf should receive dry fed concentrates at three weeks and even at two weeks if in company with older calves, may commence to nibble such food. Long hay should always be within reach but as with concentrates only a small amount should be given at a time and never left to grow soiled and lose flavour. It is also essential to have fresh water available. It will be surprising to many who do not do so, to know how much water young calves do consume. At the risk of being taken to task in that I am aware many do successfully rear calves on gruels—I condemn the practice in that there is a danger of these fine meals being washed into the bowel undigested and setting up irritation and digestive disorders. Especially as there is a craving, at this time, for some bulky material to develop the rumen. So much excellent work has already been carried out and written that it is unnecessary for me to deal with milk supplements and substitutes. What I really wish this article to convey to you as progressive breeders is this, no matter what be your system of feeding, be certain that it is adequate to maintain the calf's inherited growth rate. Then and then only will you be able to know the good doers from the bad. It is with regret one thinks of the potentially good cows that have been ruined as calves.

The view is held by many that dairy heifers can be spoiled by excessive feeding while young and I endorse that view, but I maintain it is wrong to starve them during the winter months in order to see the marvellous recoveries they make when put out to grass. The better policy is to maintain a steady rate of growth from birth onwards and select from such stock the type or types desired for future breeding stock.

FERTILITY IN SHEEP

By J. Hammond

School of Agriculture, Cambridge

THE sheep is a most useful animal in wartime, and we should not only strive to maintain our stocks of breeding ewes but also increase them. The sheep, next to the dairy cow, is the most economical converter of grass into human food, for it converts the flush of spring grass to milk, and this milk is the most efficient growth-producing food for the lamb. In the winter, too, the ewes will clear up the rough herbage on the grassland and improve it for other stock, such as dairy cows, in the summer. On light arable land, too, the sheep is invaluable in manuring the soil for the succeeding corn crop.

Process of reproduction

The ewe sheds one or more eggs at the end of her heat period. These eggs, which are like a hen's egg in miniature, are produced in the ovaries and are shed into the tops of the female tract. Here they meet the sperm from the semen of the ram. One sperm then unites with each egg shed, and the fertilized eggs then pass to the uterus and develop there.

A low lambing percentage results from two causes. First, because only one egg, instead of two, is shed at each heat period, and secondly, because there are not enough sperms in the semen of the ram to unite with all the eggs shed. Although only one sperm is required to fertilize an egg, yet, because the chances of any one sperm being at the right place at the right time to fertilize the egg are very small, a very large number of sperms have to be present in the ejaculum of the ram before he is capable of fertilizing all the eggs

produced by the flock of ewes to which he is mated.

Number of eggs produced by the ewe

The number of eggs which ripen at the heat period depends on the level of a special substance in the blood. This special substance comes from the anterior pituitary, a small gland lying at the base of the brain. If extracts of this gland are injected into a ewe about three days before she is due to come on heat, 7—9 eggs can be caused to be shed instead of the normal 1—2 eggs. It is the amount of this substance normally present in the blood which causes the difference in fertility between one breed and another.

It is no good having high fertility in the ewe unless she has sufficient milk to do the lambs well. The fertility of any breed can be improved by selecting and breeding from twin rams: a well-grown twin ram lamb is an indication not only of the fertility, but also of the milking qualities of his dam.

To produce the maximum number of eggs of which she is capable, a ewe should be in hard thriving condition at the time she is mated. She should not be too fat nor too lean nor going back in condition at the time of tupping. This hard thriving condition may be obtained in several ways. By flushing the ewes, that is, by giving extra feed for about three weeks before and during the time the ram is with the ewes, more eggs can be made to ripen. This can be done in arable sheep by running them thinly on fresh land, such as a stubble with a good growth of young seeds under it, or on a crop of rape or mustard. With grassland sheep, a fresh pasture of short young grass which is sweet as a result of liming or treatment with phosphatic manures is a suitable place for tupping. If flocks are large, they will benefit from being broken up into smaller lots and run more thinly on the ground at tupping time.

Ewe lambs tend to begin slightly later and cease breeding slightly sooner than the older ewes. Flock owners who try to produce early lambs are troubled in some seasons by the fact that the ewes come to the ram very slowly, so that lambing time is a long drawn-out affair. Under these conditions, fertility is also usually poor. In these cases, the flushing of the ewes, as described above, is of assistance.

Although injections of this anterior pituitary substance, or substances of like nature, are still in the experimental stage so far as practical sheep-farming is concerned, they show promise of proving useful.

In a certain number of cases, especially just after and before the beginning and end of the breeding season, the ewe will take the ram after one injection only, but usually it requires two injections at an interval of 16—17 days—the usual interval between heats in the ewe—before this occurs. It has been found possible by these injections to make the ewes breed twice a year.

In practice, injections of anterior pituitary may be found useful for ewes which have slipped their lambs during the winter months or are otherwise barren. Instead of keeping them a whole year with no return, except for their wool, or sending them for slaughter if ewe stocks are short, they can be injected and mated up in early spring so as to produce a crop of lambs in the autumn on the flush of grass which often occurs then.

The chief objections to breeding from an ewe lamb are that it stunts the growth of the ewe, the lambs are born weak, and the ewe has little milk, so that the lamb does not thrive well. There are ways, however, of getting over these difficulties; it might be as well to consider these under present conditions when breeding from the ewe lamb will lower the cost of production and speed up increases in the ewe flocks of the country.

It is during the last month of pregnancy that the growing lamb makes most demands on the mother's nutrition, and it is during this time that the udder is making most of its growth. If the ewe can be well fed at this time, then the difficulties in breeding from ewe lambs will be overcome.

Better feeding of the ewe lambs for 3—4 weeks before the birth of their lambs can be obtained by mating them up a month or so later than the older ewes. In grassland flocks, this means putting the ram in about the first week in December so that the ewes will lamb down in the beginning of May after they have had three weeks of grass feeding.

The percentage of lambs obtained from ewe lambs is not high; on the average it is about 70 per cent, but it is better than keeping them a whole year with no return except their wool. If any difficulty is experienced in getting the ewe lambs to come to the ram when they are required to, injections of anterior pituitary substance can be used successfully; this has been shown in experiments made during the past year. One advantage of breeding from ewe lambs in their first year is that they make better mothers in their second year than those which have not been bred from in their first year.

Fertility of the ram

Lambs cannot be produced in greater number than the eggs shed by the ewe, but if the ram is not of full fertility, there may be many more singles than there should be. To avoid disappointment it is as well to change the rams on the 16th day, the average time between one heat and the next in the ewe, using a different coloured raddle so that the ewes which turn can be observed. To be on the safe side, about 3 per cent of rams are required with the ewes, and rather more if ram lambs are used.

High temperatures are very harmful to the sperm of the ram and soon cause infertility. The purpose of the scrotum is to keep the testes at a lower temperature than the body; where the ram is to be used in the warm months of the year, it is advisable to see that the wool is removed from the scrotum, so as to lower its temperature, about a fortnight before he is to be used. A ram which for any reason (very high condition, disease, etc.) has recently been in a feverish condition is unsafe to use for breeding purposes; such effects, however, are not always permanent and recovery may be made in another season or later in the year. So far, we have not been able to find any injection which will increase the fertility of the ram, but if at the beginning of the season the ram is slow at his work, he can be stimulated to activity by injecting anterior pituitary gland extract, using about double the dose one uses for an ewe.

In conclusion, it should be emphasized that there are times in the year when a little extra trouble in the management of the flock is well worth while. Such a time occurs at tupping, for on the condition of the flock then depends the fall of lambs in the following season.

Another such critical period in the management of the flock occurs during the month before lambing is due to begin, for on the proper feeding of the flock at this time depends the strength of the lamb at birth and the supply of milk for the new-born lamb, which is the most important factor in the growth and economic success of fat lamb production.—*The Journal of the Ministry of Agriculture*, Vol. XLVII, No. 2, Sept. 1940.

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'BUBBLE AND SQUEAK' SILAGE

SILAGE is very much to the fore these days, and we hear much about potatoes. The Dutch have a simple method of dealing with potatoes intended for stock feeding. It might usefully be applied to the surplus, undersized tubers from the present crop. Newly mown pasture grass (ryegrass, clover, etc.) is mixed with the potatoes in a stack silo. No building or excavation is required, the materials being built up on a level site. First of all, a layer of grass about one foot thick is placed on the ground; then a layer of potatoes, followed by another layer of grass, and so on until the stack is completed. In Holland, about three tons of green grass are used to one ton of potatoes, but English experiments have shown that the proportion of grass can be considerably reduced. The potatoes are not prepared or treated in any way beyond a preliminary riddling to remove loose earth and any sprouts that may have begun to grow. When building up the silo, it is convenient to make a runover heap. When complete, the sloping ends or ramps are cut away and the material is thrown on the top. The next day a layer of about one foot of soil is placed on the top, and a few days later the sides are also covered with soil. The heat developed in the silo cooks the potatoes, and the final product is sweet and pleasant in smell.—*The Field.*

PROSECUTION UNDER DAIRY INDUSTRY ACT

ON August 9, 1940, Mr W. Burgess, proprietor of Omemee Creamery, Omemee, Ontario, was fined $10·00 *plus* $13·00 costs by Magistrate Gee of Lindsay for having manufactured and sold butter containing more than 16 per cent water and less than 80 per cent of milk fat.

Manufacturing butter of such composition is a violation of both the Dairy Industry Act administered by the Dominion Department of Agriculture and also Regulations under the Ontario Farm Products, Grades and Sales Act. These Acts state in effect that no person shall manufacture, import into Canada, sell, offer or have in possession for sale any butter containing more than 16 per cent water or less than 80 per cent milk fat. Butter which does not conform to these standards of composition is deemed to be adulterated. The information was laid by a Dominion Inspector of Dairy Products.—*Dairy News Letter.*

New Books and Reviews

A Survey of Insecticide Materials of Vegetable Origin

By H. J. Holman, B.Sc., A.R.C.S., D.I.C., A.I.C. (The Imperial Institute, London, 1940, pp. 156, 3*s.* 6*d.*)

THIS is a timely book which will be of the greatest use to India. At the present day the production of insecticide materials derived from plants is of increasing importance in Empire countries. The production of derris root in Malaya and of pyrethrum in Kenya are recently established industries and in India experiments on the cultivation of pyrethrum have already reached an advanced stage. The book gives detailed information about the pyrethrum industry and the description covers the chief producing countries, experimental cultivation in the British Empire and in other countries and the consumption of pyrethrum. Other insecticidal materials discussed include nicotine, anabasine, plants containing rotenone and allied compounds, quassia and plant oils.

Information as to the sources of these materials and their production and trade is not easily available and this useful work presents a survey of the correct position for the benefit of actual and potential producers as well as buyers and users. To assist those desirous of obtaining further information, references have been given to all the more important literature.

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The Principles of Fumigation of Insect Pests in Stored Produce

(H. M. Stationery Office, 1940, pp. 28, 6*d.*)

EVERY year insects damage or destroy millions of pounds worth of stored produce, mainly foodstuffs. The ravages of these destructive pests can be prevented to a great extent simply by keeping the warehouses clean. But if the produce or the warehouse is badly infested, it may become necessary to adopt other methods, such as fumigation, to rid them of infestation. Fumigation is a job which must be carried out by experts. The Department of Scientific and Industrial Research has just issued a pamphlet describing the scientific principles underlying the successful fumigation of insect pests that infest stored produce. This pamphlet is intended to help the expert to apply the results of the most recent findings of science in this important and practical field.

After discussing the varying nature of fumigants and describing suitable apparatus for vapourizing these where necessary, graphs are given to show how stirring the air aids the effective distribution of the fumigant.

Penetration of the gas into the goods depends on how the produce is stacked, while the nature of the building affects the amount of fumigant which will 'cling' or leak away. Suggestions are made for the most effective use of the fumigant, and for ventilation of the building afterwards. Finally the pamphlet deals with the means for observing the effectiveness of the fumigation in killing the insects in all parts of the building.

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Kapas, Bhag I & II; Bagabagicha: Khetine Mula Tatvo, Bhag I

By Martand Shivabhadra Pandya, B.Ag., B.Sc. (Available from the author at Baroda. Pp. 168, Re. 1; pp. 230, Re. 1-4; pp. 280, Re. 1-8; pp. 88, 6 as.)

COTTON, Part I. The book is written in simple language. On the whole it will be more useful to a student of cotton than to the cotton cultivator as it contains much general and scientific information.

Cotton, Part II. The language is simple and could be easily understood by literate cultivators. Generally, the book will be of value to all who are interested in cotton. Chapters 4 to 12 dealing with climate, soil, manure, tillage, pests, etc. will be appreciated by cotton cultivators.

Bagabagicha (Gardening). The book is written in simple language. It contains much

practical and useful information on ornamental, vegetable and fruit gardening and will be of value to all those interested in these aspects of horticulture.

Khetine Mula Tatvo (*Elements of Agriculture*). The book gives elementary instruction about soils, the formation of soils, soil constituents, the physical properties of soils, soil in relation to water and the plant, tillage, implements, etc. and will serve as a useful textbook in primary Gujarati schools where agricultural subjects are introduced. The language is such as could easily be understood by boys studying in the fourth and higher Gujarati standards.

[W. J. J.]

Rag Bag

Advice on apiculture

FROM time to time enquiries are received in the I C A R concerning beekeeping appliances and advice on apiculture. The Entomological Section of the Imperial Agricultural Research Institute, which was responsible for the pioneer work on the fundamentals of beekeeping in India and for a bulletin still considered to be up-to-date on the subject, is always willing to help with advice and appliances. Enquiries should be addressed to the Imperial Entomologist, Imperial Agricultural Research Institute, New Delhi.

***

Rice marketing

THE organization of produce marketing in India is still in the pioneering stage. The hardships and rewards of this enterprise can be judged from the following extract from the Annual Report of The Dehra Basumati-Rice Producers' Cooperative Marketing Society Ltd., Dehra Dun, for 1939-40 :

'At the beginning the Society had to face all-round opposition of the local dealers and critics of cooperative societies and could not undertake propaganda for want of funds. The result was that up to February 1939 sales were not very encouraging. But it is a matter of great pleasure for all to note that since February 1939, when the Marketing Department of the Government of India undertook the work of grading the rice in three different grades known as Special, A and B, according to the specifications fixed by the Agricultural Marketing Adviser to the Government of India, and the rice began to be sold under the 'Agmark' seals and labels, the sales rose so high that the Society began to feel difficulty in meeting urgent demands. During the year under report the Society disposed of 3,233 md. of rice worth Rs. 23,284, and this was distributed from Quetta to Coorg and Karachi to Assam in India, and abroad. The total profit of the Society for the year was Rs. 929-11-0.'

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INDIAN FARMING

ISSUED BY
THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

Vol. II, No. 4
APRIL 1941

Subscription ; Rs. 6 per annum : 8 as. per copy

PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
PRINTED BY THE MANAGER, GOVERNMENT OF INDIA PRESS, CALCUTTA

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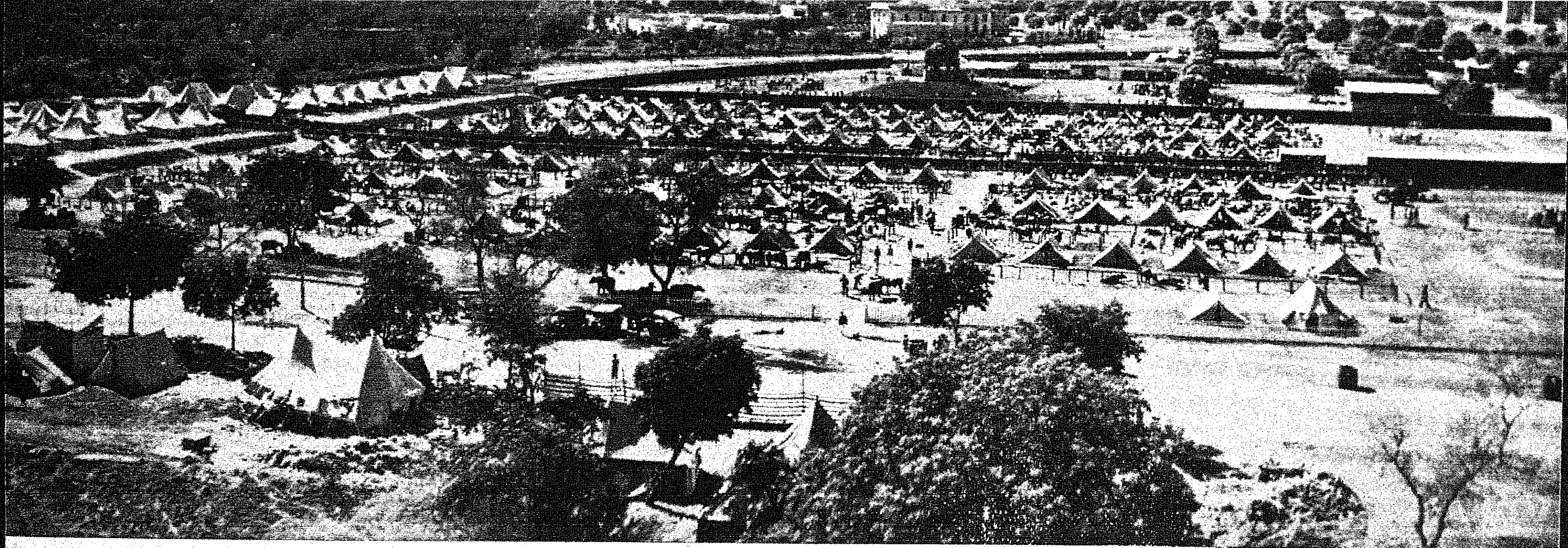
Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Imperial Council of Agricultural Research, Imperial Secretariat, New Delhi.

The subscription is Rs. 6 per annum, 8 as. per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertisements should be made to the Manager of Publications, Civil Lines, Delhi.

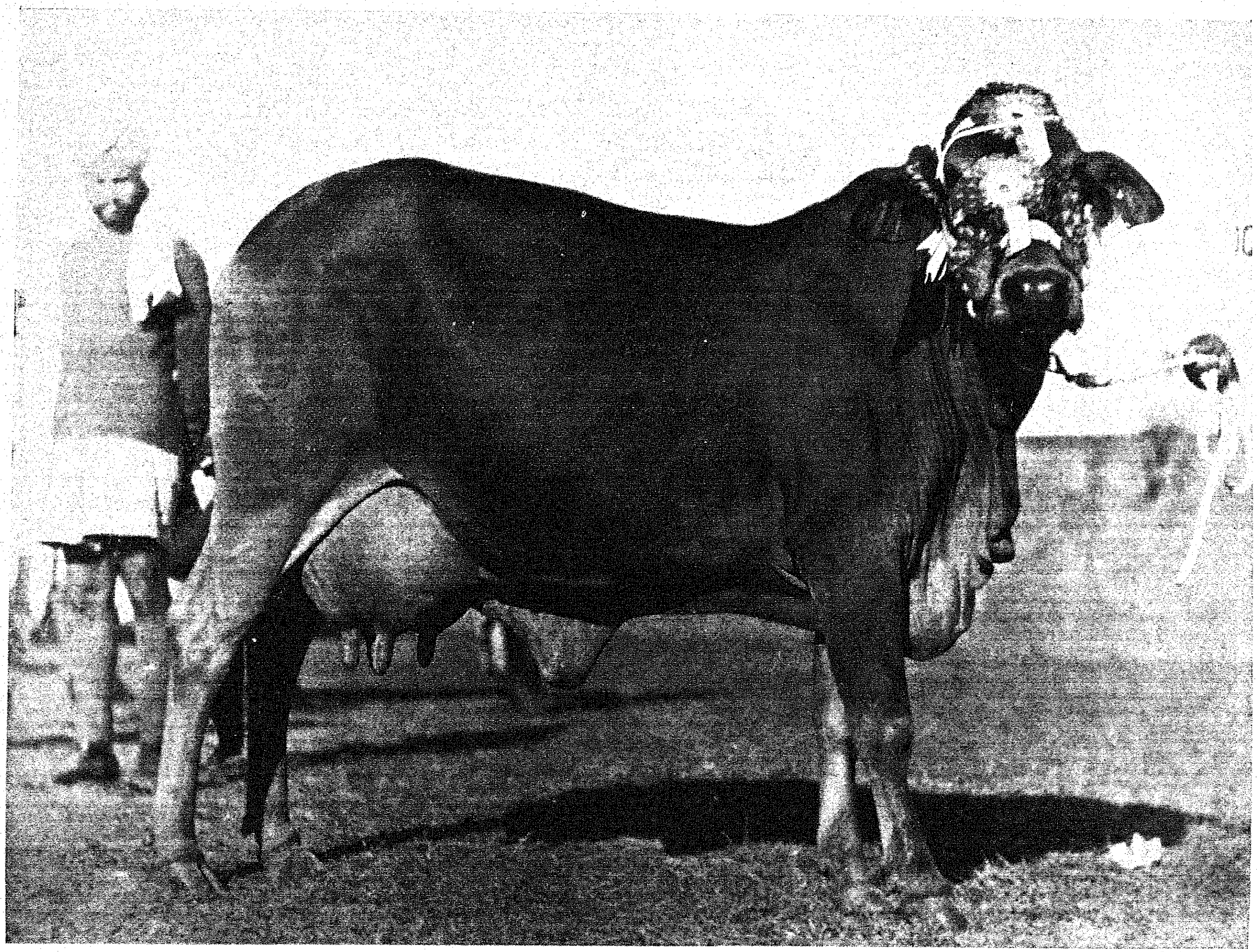
Subscribers in Europe and America should apply to the High Commissioner for India, Public Department (Publication Branch), India House, Aldwych, London, W.C. 2.



Simla Studios

The All-India Cattle Show : A panorama

The Show attracted a record of 820 entries this year. On the left are the tents of officers from provinces and states who accompanied their exhibits.



Ved & Co.

Champion of 1941

Mudini, a Sahiwal cow owned by the Military Dairy Farm, Ferozepore, was adjudged to be the best animal in the Show, and won the Viceroy's Cup in addition to other prizes.

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THE FOURTH ALL-INDIA CATTLE SHOW

WHEN the history of the All-India Cattle Show Society comes to be written, probably one of the most remarkable achievements to be recorded will be the fact that in this War year of 1941 not only was the Show held at New Delhi in February as usual, but that the number of entries received was greater than in any previous year.

The figures for entries over the four years during which the Show has been held are very striking: 488 in 1938, 637 in 1939, 706 in 1940 and 816 in 1941.

Great credit is due to the Cattle Show Officer, Khan Sahib Ghulam Hasan, who, we are glad to see, was awarded an M.B.E. for his labours in the New Year's Honours List, for having encouraged breeders to support the Show just concluded to this extent, but we think we can see in these figures the feelings of breeders themselves that whatever else is kept in abeyance an industry which means so much to India in every way must not be allowed to languish at times like this. Moreover, those with foresight will have appreciated that when the war ends there will be a demand for pedigree cattle in many parts of the tropical world and if India is ready with such stock she should be able to capture a valuable market.

Opinions were expressed on many sides that not only were the entries this year more numerous, but the quality also continues to improve, and this may be said not only of the cattle but also of the buffaloes, of which there was a great exhibition of the three Punjab breeds, Murrah, Nili and Ravi.

The fourth Show will be remembered for the triumph of the Military Farms Department who with their beautiful Sahiwal cow, Mudini, from Ferozepore swept the board in all the milch cow classes and annexed His Excellency the Viceroy's Cup for the best animal in the Show. This cow is an outstanding example of what can be done by careful breeding for both conformation and performance. In her last lactation she completed over 11,000 lb. and she has twice won the milking competition at the all-India Show, this year with a daily average of 51 lb., but her greatest achievements at the Show are due to her conformation, which, as her picture shows, is everything that a Sahiwal cow should be.

Both the Supreme Championships for buffaloes were won by Nili animals, the bull coming from the Military Dairy Farm, Ferozepore, and the cow being owned by a ryot from Montgomery district.

The best bull in the Show this year was adjudged to be a Sindhi bull shown by the Livestock Officer, Sind, after a close contest with a Kankrej bull from the Chharodi Farm, Bombay.

As many as 19 breeds of cattle and seven breeds of buffaloes were exhibited at the Show, the most notable absentees being breeds from the south like the Khillar, Hallikar and Ongole. We also missed seeing a previously regular attendant at the Show in that well-known cattle breeder, the Pattagar of Palayakottai, and his Kangayam cattle.

This year a Poultry Section was added to the Show and also a Students' Judging Competition, and both of these excited a good deal of interest. Four hundred and fifty exhibits

were received for the Poultry Show from places as far apart as Dacca and Parachinar (N.-W. F. P.), and keen competition was shown for the numerous prizes offered. As usual, White Leghorns and Rhode Island Reds, both exhibition and utility, were to the fore, but there was a good entry of country breeds such as the Chittagong and Naked Neck, and the Aseel was particularly well represented.

The Viceroy's Cup for the best bird in the Show was won by a White Leghorn hen belonging to the Kingsway Poultry Farm, New Delhi.

So much interest was shown in this section of the Show that it was decided to hold a meeting of the All-India Poultry Club during the week, when future policy was discussed and officers appointed for the current year. The new Secretary is Mr A. J. Macdonald of the Poultry Research Section, Imperial Veterinary Research Institute, Izatnagar, U. P., who will be glad to answer enquiries and receive applications from those desirous of joining the Club.

In the Students' Judging Competition, for which nine teams entered, the winners proved to be a team from the Lyallpur Agricultural College, so that they become the first Institute to annex the challenge shield kindly presented for this competition by Messrs Polson, Ltd., Bombay.

Another important happening during the Show week was the holding by the newly registered Sahiwal Cattle Society of India of its first meeting under the presidentship of Capt. U. W. F. Walker, Director of Veterinary Services, Punjab. The Honorary Secretary of this society is Lieut.-Col. C. E. MacGuckin, Inspector of Military Dairy Farms, Lahore Cantonment. We wish the Society every success in its endeavours to foster and develop this important milch breed and we hope it may be the forerunner of similar societies for the other important breeds of India.

A. M. LIVINGSTONE
C.I.E., M.C.
An Appreciation

MR Archd. McD. Livingstone, Agricultural Marketing Adviser to the Government of India, who has just left India to resume his duties with the Ministry of Agriculture in London, has throughout his career been closely associated with agriculture.

On leaving school he entered the office of the Duke of Hamilton's Kinneil estate, closely adjoining the estates of the present Viceroy. After serving his time there he took a period of training under a good old-fashioned Scottish farmer who believed in a student working harder than anyone else on the place. Subsequently he proceeded to Edinburgh University where he took a degree in Agriculture and later in Arts and between times got further practical experience of farming in Perthshire and organizing small-holders in the north of Scotland.

On the outbreak of War in 1914, he was soon commissioned from the University Officers Training Corps, joined the Royal Field Artillery and spent most of his active service in France with the Guards Division. He was decorated with the Military Cross. During the latter half of the War, he commanded a field battery and for a time towards the end had charge of a brigade of artillery.

On demobilization he went up to the School of Rural Economy in Oxford and was subsequently posted as Farm Costings Officer for south-eastern Scotland under the Corn Production Act. Later, when the scheme for the payment of guaranteed prices to farmers was finally abandoned and the Act repealed, he joined the East of Scotland College of Agriculture as Lecturer on Farm Accountancy and Economics.

Archd. McD. Livingstone, C.I.E., M.C.
Late Agricultural Marketing Adviser to the Government of India

[PLATE 43

In 1924 he was asked to join the new Markets Division which the Ministry of Agriculture in London proposed to create and continued to serve there as Senior Marketing Officer until 1934. During this period he was closely associated with the development of the National Mark Scheme and the establishment of Produce Marketing Boards.

As a result of the recommendations of the Royal Commission on Indian Agriculture the Imperial Council of Agricultural Research proceeded to the appointment of a Marketing Expert early in 1934, and Mr Livingstone's services were secured on loan from the English Ministry of Agriculture for a period of three years, which was subsequently extended from time to time so that altogether he was able to spend seven valuable years in India.

The Office of the Agricultural Marketing Adviser to the Government of India was established on 1 January 1935. Since then by building up and training a useful and capable central marketing staff and full-time staffs in the provinces and major states—consisting of 100 officers in all—it has been possible for him to accomplish much useful work of a practical character for the improvement of agricultural marketing in India and at the same time lay a sound foundation for future progress. Much of this work has been recorded in comprehensive reports on the marketing of wheat, linseed, eggs, tobacco, coffee and grapes. Abridged editions of some of these reports in English and Indian languages are available. In 1941 Mr Livingstone was made a Companion of the Most Eminent Order of the Indian Empire.

Original Articles

JAMS, JELLIES AND MARMALADES FROM PUNJAB FRUITS

By

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and

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INDIA imports jams and jellies worth about six to seven lakhs of rupees annually. In addition to this, fairly large quantities of local products (home-made or commercial) are consumed. Demand for such products can still further be increased if the available resources of the country, viz. cheap fruit (third-grade cull fruit unfit for table purposes), cheap labour, etc. are utilized. These potentialities, coupled with an up-to-date knowledge (seriously lacking at present) in the technique of all aspects of fruit and vegetable preservation could give a great impetus to this industry. Admittedly, therefore, at this stage, the technical side of this subject requires attention.

It is gratifying to note that the systematic work on the standardization of different kinds of fruit and vegetable products, which has been in progress in the Punjab since 1934, has contributed a good deal towards the solution of this problem. Observations recorded in the preparation of jams, jellies and marmalades from some Punjab fruits (pears, plums, guavas, citrus fruits like oranges, *sangtras*, etc.) form a part of the work in hand.

What is a good jelly or marmalade?

A perfect fruit jelly should be sparkling, transparent and attractive in colour, and should have a strong flavour of the original fruit. It should not be gummy, sticky or syrupy and when cut with a knife it should have a sharp edge, and a clear cut surface. A jelly may be thick-set or soft-set. Any of the above types of jellies in which pieces of fruit are suspended is called a marmalade. The term marmalade, in this country, is usually associated with a product made from fruits like oranges and lemons. In this case, the suspension in the jelly is the shredded peels of these fruits.

Jelly-making consists of boiling a clear fruit juice extract with an adequate quantity of sugar to such a stage that when allowed to cool, it will form a jelly.

These principles, as given below, also apply to the making of marmalade.

Fruit jellies are made from fruit juices which consist chiefly of water in which are dissolved small amounts of naturally occurring substances like sugars, acids, pectins, proteins, flavouring material, etc. Sugar must always be added as its natural occurrence is not sufficient to make a jelly. Some fruit juices are deficient in either pectin or acid, or in both, and in such cases, a correct balance of these for jelly-making has to be obtained by adding one or both of these ingredients in definite proportions to obtain a good fruit jelly.

Occurrence of pectin in fruits

Pectin, as mentioned above, occurs naturally in practically all fruits. Its quantity, however, varies with different kinds and even with different varieties of the same fruit. The largest amount of pectin occurs when a fruit has attained its full size and is reaching maturity—a stage just preceding the eating ripe stage. This type of fruit should be used for jelly-making. Pectin content of fruits also increases during dry seasons and is less during moist weather.

By boiling the fruit in adequate quantity of water, the pectin comes out from the fruit tissues in which it is held. All the above

factors should be carefully considered before selecting fruit for jelly-making.

Fruits deficient in acid, as a rule, do not make good jellies. In such cases a little lemon or lime (*kaghzi-nimboo*) juice, citric acid or tartaric acid must be added. Sufficient acid, in either of the above forms, should be added to give the juice a sourness roughly the same as in sour apples. Addition of one to two pounds of lemon or lime juice, or one to two ounces of citric or tartaric acid (preferably citric acid) per 100 lb. of juice extract (low acidity) will give the desired acidity.

Method of jelly-making

All firm fruits should be cut into thin slices, covered with water, and boiled in covered kettles or saucepans preferably of aluminium. For home production cooking may be done on open fire, but for semi-commercial or commercial production double-jacketed steam kettles should be used. These kettles are available in varying sizes and are made of copper, aluminium, monel* metal or stainless steel (for jams and jellies copper should be avoided). Inside the double jacket, a coiled steam pipe is fitted, one end of which is attached to the steam feed (40-80 lb. pressure) and the other is fitted with a safety valve to permit steam to escape in case of excessive pressure. These kettles ensure regular heating and avoid cooked or burnt flavours in the product.

The fruit should be boiled just enough to soften it. When the fruit becomes soft enough, the whole mass is placed in a jelly bag or double layer of cheese cloth or any other suitable thick cloth and the clear extract allowed to drip. The juice must on no account be forced out by pressing. The first extract always gives a product of good quality, but the general practice is to add more water to the residue and boil for a short period to extract more pectin. This may be mixed with the first extract.

Addition of sugar

To avoid scum-forming during cooking (see below) which, unless removed, impairs the clarity of the jelly, only the best quality crystalline sugar should be used. Too much sugar is liable to produce a syrupy jelly and may even result in crystallization; on the other hand, an insufficient quantity of sugar sometimes gives a tough jelly. The amount of sugar required to make a good jelly depends upon the quantity of pectin and acid present in the juice, the former being more important.

To ascertain the quantity of pectin present in the juice extract, two tests are generally employed.

Alcohol test.—Take a teaspoonful of cooled juice in a small glass tumbler or a beaker and add to it two teaspoonfuls of methylated spirit, shake gently and allow it to stand for a while. Pour out the mixture on to a plate and note the size of clots it drops in. These clots (Fig. 1) indicate the amount of pectin present.

(i) A number of small clots (Plate 44, Fig. 1 A) indicate pectin present in small quantities and sugar added should be half a cup or half a pound for every cup or pound of juice extract. It is, however, advisable in some cases, to concentrate the juice to increase the pectin content.

(ii) When two or three clots (Plate 44, Fig. 1 B) are formed, $\frac{3}{4}$ cup or $\frac{3}{4}$ lb. sugar should be added for every cup or pound of juice extract.

(iii) If only one large clot is formed (Plate 44, Fig. 1 C), it indicates that the juice is rich in pectin and an equal measure or weight of sugar should be added.

Jelmeter test.—The jelmeter (Plate 44, Fig. 2) recently invented by Prof. Baker of Delaware University (U. S. A.) is a very handy and simple device (costing about Rs. 9) and is now commonly used for determining the right amount of sugar for making jams and jellies. The test applied by this instrument is more accurate than the alcohol method. The method of using this instrument is briefly described below.

Hold the jelmeter in upright position (Plate 44, Fig. 2) in the hand, closing the narrow end with the little finger. Pour the cooled juice extract into the jelmeter through its wider end and fill it to the top (brimful). Remove finger from the bottom and let the extract flow or drip exactly for one minute,

* A non-corrodible alloy of nickel, copper, manganese, etc.

replace the finger and note the nearest graduation mark on the jelmeter where the level of the juice stands. This reading shows the cup or pound of sugar to be added for each cup or pound of juice extract.

For jams, 4 oz. of sugar are added in excess to the jelmeter reading for every pound of juice extract.

In case the juice extract is very rich in pectin and the level, after the test, does not go below the uppermost mark of the jelmeter, the juice extract may be diluted slightly. If, however, the extract is very poor in pectin and flows below the bottom mark, it should either be concentrated by further boiling, or powdered or liquid pectin should be added to get a suitable reading on the jelmeter.

Cooking or boiling

Put the strained juice in an open pan preferably of aluminium (for large-scale production use steam-jacketed kettles) and add the requisite amount of sugar (as determined by the above tests) and heat the mixture to boiling point. Strain it hot through a double layer of thick cloth, or preferably a felt bag, to remove sugar impurities. Replace and boil again, removing any scum that may appear. Cook until any of the following tests are obtained.

Sheeting test.—Take up a little of the boiling mixture in a ladle, allow it to cool a little and let it drip (Plate 44, Fig. 3). If the jelly flows down in thick drops (Plate 44, Fig. 3 A), more cooking is required, but if it drops in flakes (Plate 44, Fig. 3 (B) the jelly has reached the final stage.

Drop test.—A drop of the boiling mixture is placed on a cold china plate from time to time and the condition of the drop by experience indicates the finishing point. This test is not so rapid and accurate as the above test.

Temperature control test.—If correct proportions of sugar, acid and pectin are used, then a proper jelly will be formed when the mixture reads 222°F. at sea-level, i.e. further cooking should cease when the above temperature is reached. This temperature, i.e. 222°F., may be decreased by 1° for every 500 ft. rise in the altitude from the sea-level of the place where the jelly is prepared. For instance, at an elevation of 2,000 ft. above sea-level, the cooking should cease when the temperature of 218°F. is reached.

For home production, an ordinary but accurate Fahrenheit thermometer can be used, but for large-scale production where boiling is done in steam-jacketed kettles, a special jelly thermometer (Plate 44, Fig. 4) should be used on this. The operator can read the temperature while standing at a distance from the boiling pan.

Weight method.—In the case of jellies, after making the jelmeter test, as directed above, weigh the juice extract and add sugar as shown in Table I; cook until the weight indicated for jellies in Table I is obtained.

TABLE I

Cooking weight of jams and jellies

Jelmeter test figures on nearest line	Sugar to add for each lb. of juice extract				Cook to weight			
	Jellies		Jams		Jellies		Jams	
	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
1¼ . .	1	4	1	8	2	0	2	6
1 . .	1	0	1	4	1	10	2	0
¾ . .	0	12	1	0	1	4	1	10
½ . .	0	8	0	12	0	14	1	4

Directions for cooking jams are the same as for jellies but the amount of sugar to add is increased. In this case, cook to weight as shown for jams in Table I.

The weight method is generally used for home-scale production when a jam or jelly is cooked in a kettle or pan placed on direct fire. The kettle or pan is weighed by means of a spring balance or any other convenient scale; known weight of juice extract and sugar are put and cooking is stopped when the weight (which can be calculated from Table I in accordance with the quantity handled) indicated for jams and jellies in Table I is obtained.

Filling and sealing

For production on home scale, pour the jelly or marmalade, while hot, into dry sterilized jars (previously heated in boiling water for about half an hour) or in dry tin cans previously rinsed with hot water. Allow the

contents to cool overnight, keeping them covered with a piece of clean paper or cloth. When cool, a thin layer of hot melting paraffin wax or a piece of butter paper dipped in alcohol or brandy may be put over the surface of the contents after which the containers are sealed. The lids of the jars are fixed in position and lids of the cans are sealed with a can sealer, and the product is stored in a cool dry place. For production on a commercial scale, pour the jelly scalding hot in jars or tins and seal airtight immediately. If jellies made from red-coloured fruits are filled in tin cans, the inside of the can should be heavily lacquered to prevent bleaching of colour.

Jam-making

Ordinarily, fruits unfit for fresh market or canning, such as those damaged by hail-storms, blemished or slightly over-ripe or under-ripe, etc. are used for jam-making.

Soft fruits like berries may be washed. Stone fruits can be made into jam with or without stones. Hard fruits should be softened by boiling.

Consistency of jam may or may not be jelly-like, but it is always desirable to have jam which sets like a jelly and in such cases a small amount of juice of the fruit used is extracted and the pectin test applied to that juice.

To determine the final consistency in a jam, it is not possible to apply the sheeting test, and therefore the temperature control method or the weight method should be applied. For home production jam may be filled in containers and sealed in the manner as described for jellies. In commercial practice, however, the product is poured, while hot, into jars or cans and immediately sealed. The filled jars or cans are then placed in an inverted position for 5-10 minutes, so that the hot jam comes into contact with the inside of the cover and sterilizes it. The containers, when quite cold, are stored in a cool, dry place.

Recipes

The product prepared from the recipes given below has been tested during two years' storage and found to be excellent.

Citrus marmalades.—Marmalade comparing very favourably with any of the imported brands can be made from the following fruits with the following combinations :

(*a*) Malta orange and *khatta* (*Citrus aurantium*) 2 : 1 by weight. (Peel shreds of Malta oranges.)

(*b*) *Sangtra* and *khatta* 2 : 1 by weight. (Peel shreds of *sangtra* oranges.)

(*c*) *Khatta* alone. (Peel shreds of Malta oranges.)

The product is likely to become dark in about 6 months' storage.

(*d*) Malta orange and *galgal* (*Citrus limonia*) 2 : 1 by weight. (Peel shreds of Malta oranges.)

Wash fruit, and with a sharp knife remove only the upper yellow portion of the skin (except *sangtras* which can be peeled by hand), leaving as much of the white portion of the peel on the fruit as possible (for making peel shreds see below). Cut the fruit into thin slices, add water just enough to cover the sliced fruit and boil for about an hour to extract pectin. Follow the directions as given for jellies, viz. strain the juice, add correct amount of sugar (it is advisable to boil the juice and strain once again before adding sugar), cook, add peel shreds which should be prepared beforehand and boil until jelly with peel suspensions is ready.

To prevent darkening of marmalade in storage, allow it to cool a little, and add potassium meta-bisulphite dissolved in a small amount of water at the rate of 4 gm. (about one drachm) per 100 lb. of the finished product. This should not be done if the marmalade is to be filled in cans.

Cut the peels of the fruit into thin or thick slices as desired, about 1 to 1½ in. long, with a sharp knife or a handworked slicing machine (for commercial production power-driven slicers can be used). To remove bitterness of the peel, boil these shreds in water for 10-15 minutes, discard the water extract and boil again in water for 5-10 minutes. Add the shreds at the rate of one ounce to one pound of original juice extract, to the boiling jelly, when a temperature of 218°F. (at sea-level) is reached. Unless added in the above manner, the shreds may not remain evenly suspended

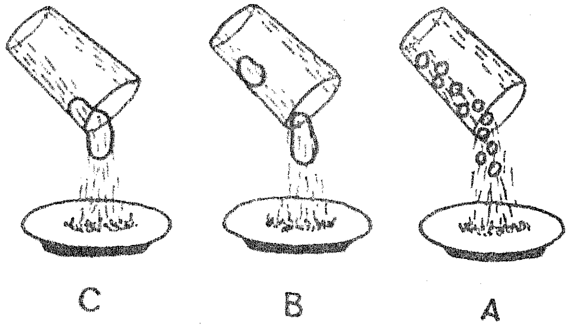


FIG. 1. Alcohol test for pectin

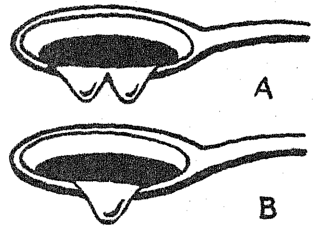


FIG. 3. Sheeting test

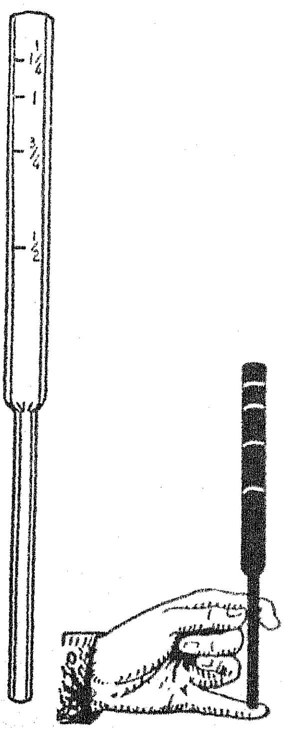


FIG. 2.

The jelmeter, recently invented by Prof. Baker, is now commonly used for determining the right amount of sugar for making jams and jellies.

FIG. 4.

For large scale production a special Jelly Thermometer should be used. The operator can read the temperature while standing at a distance.

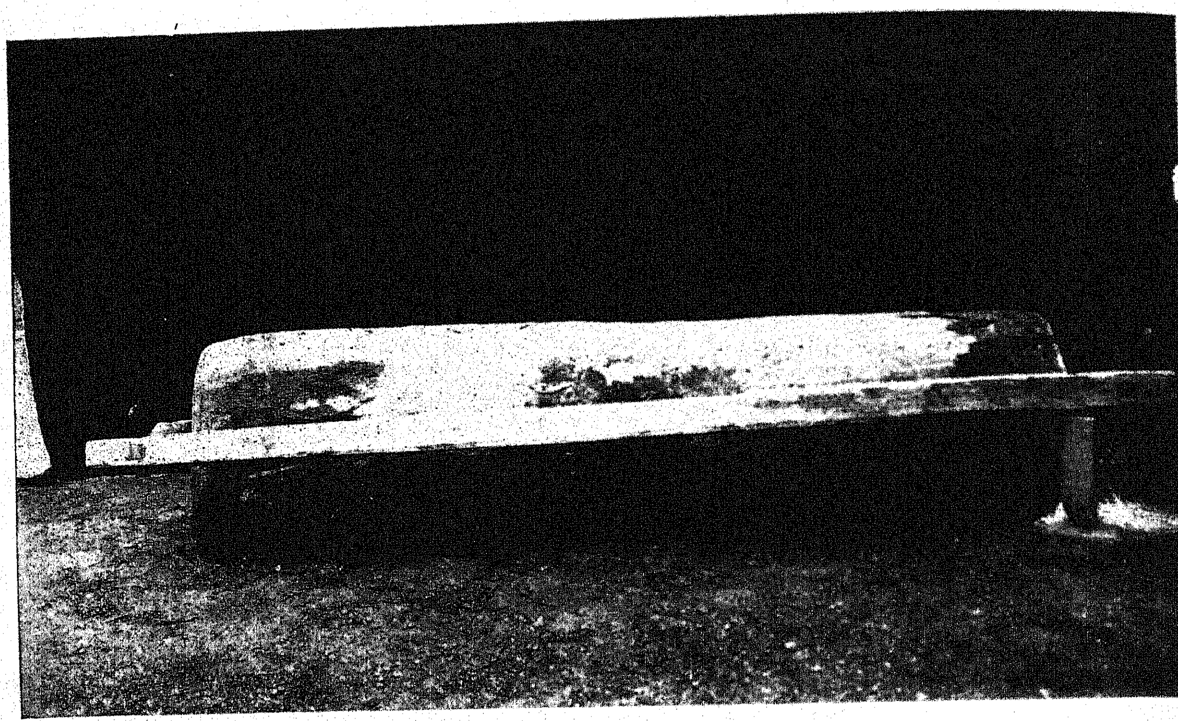


FIG. 1. Ordinary wooden roller

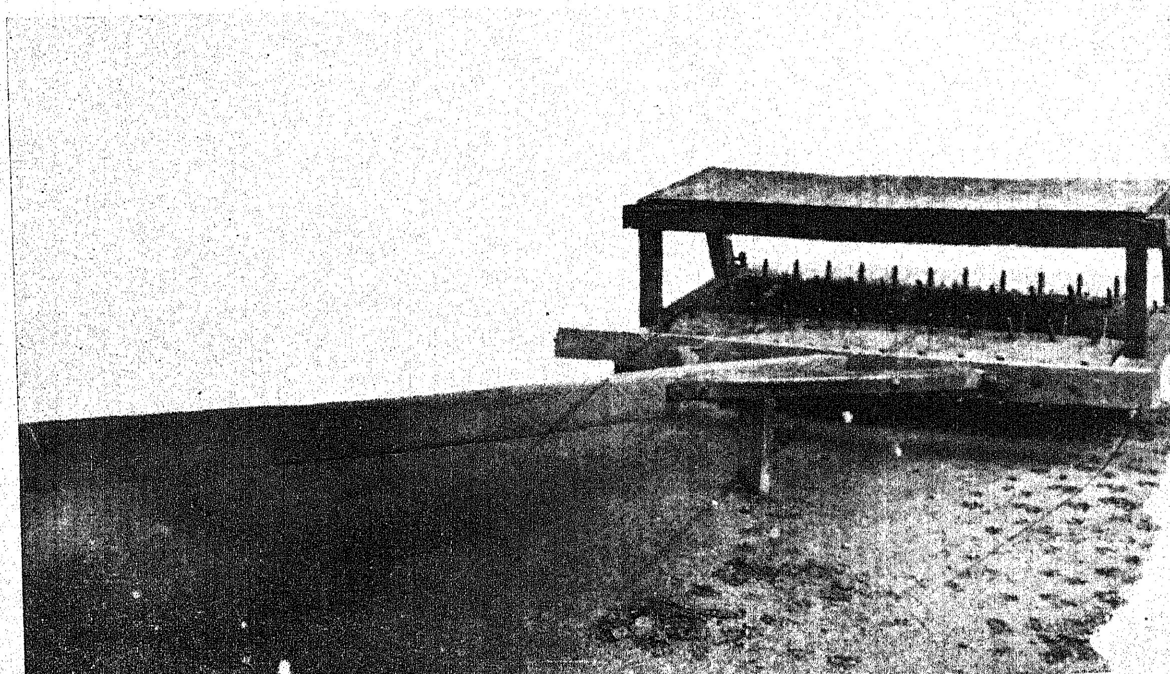


FIG. 2. Gujrat roller

of ½ in. Both the rollers are connected in a frame. A long beam for yoking and a seat above the rollers are provided.

Such a roller does two things at a time; the pegs break the crust or clods and the wooden surface presses the soil in the manner of a *girri* and hence it improves the work done by the pegs—actual trials have revealed that in moist and light soils it does not require any additional weight and even the worker need not sit on the frame. The drier and heavier the clods, the more is the weight required to be put on it. It can easily be done by placing bags full of earth or by making two or three men sit upon the frame. When it is worked twice (cross-wise), the quality of the work is considerably improved.

Pegs can be fixed to a big roller which may be made of only one log of wood, but the disadvantages are:

(i) When pegs are fixed at 2 in.×2 in., being too close to each other, they begin to serve as levellers and invariably get clogged.

(ii) For making a roller of only one big log of wood it is difficult to find the type of wood required; whereas for small rollers wood can easily be procured.

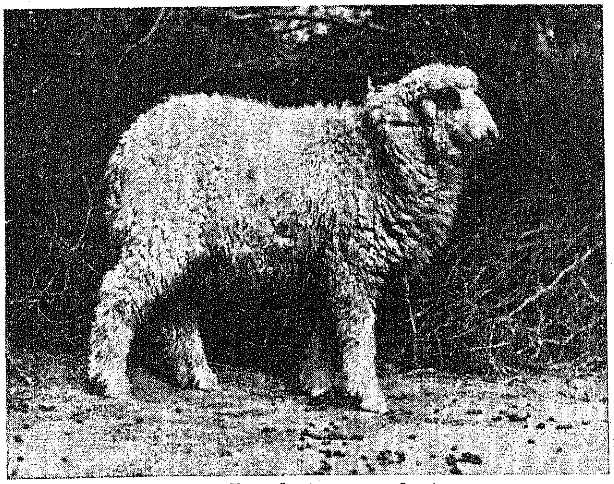
(iii) Pegs fixed to a big roller touch only one point of a clod at a time in rotating, while in the case of two rollers they touch the same point of the clod twice, thereby increasing efficiency of the work.

(iv) It is admitted that the large single roller has got the advantage of having comparatively greater weight per square inch, but the use of a heavy roller is not needed under all conditions, and therefore, it has been kept discretionary for the user to get the same result with two small rollers by putting extra weight on the frame. In other words, the heaviness or lightness of the roller under various conditions has been designed to be adjustable, while the large single roller will always remain heavy whether the user needs it or not.

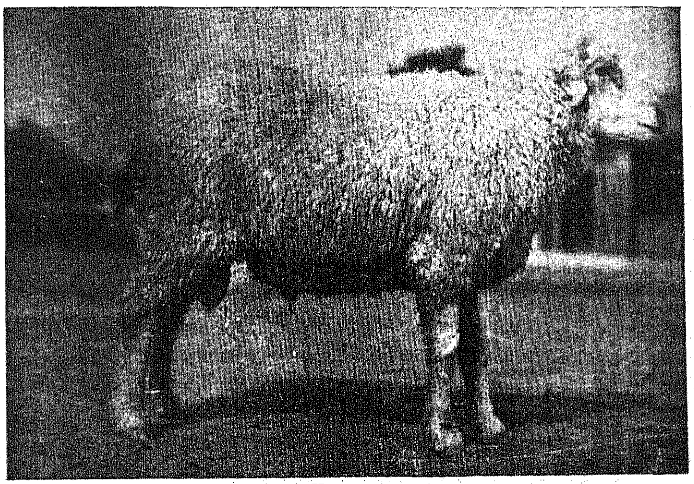
It is very cheap as compared with other makes and costs only Rs. 15 to Rs. 20. It is simple and can be made and repaired by an average blacksmith. The greatest advantage is that its draught can be adjusted, and hence even an average pair of bullocks can draw it.

Further, it can be used in place of a bar harrow in most cases. It can also be worked successfully as a thresher in supplement to the country thresher.

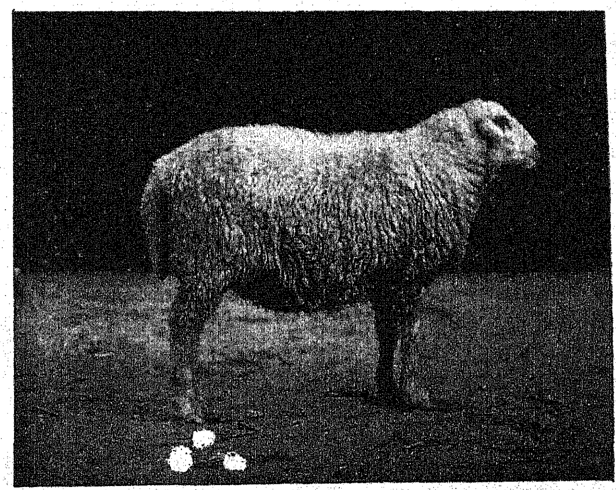
Rollers have been found to mar the road surface in transport to fields by the contact of iron pegs with it. On metalled roads rollers produce very disagreeable noise and both these contingencies are easily met by providing small wooden wheels beneath the roller. It is, however, not quite necessary to add wheels for work on *kacha* (unmetalled) roads.



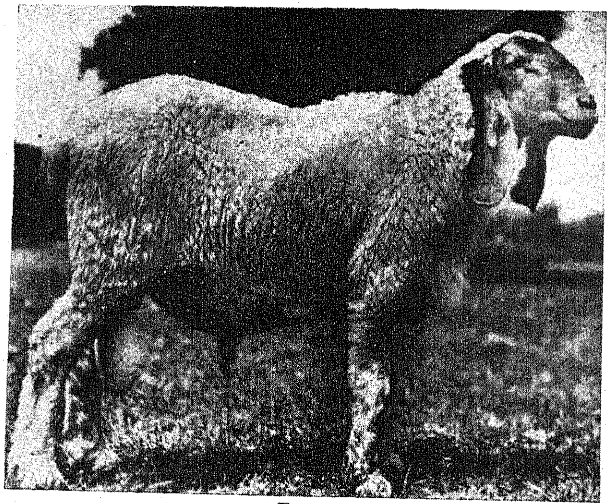
Lamb (4 months)

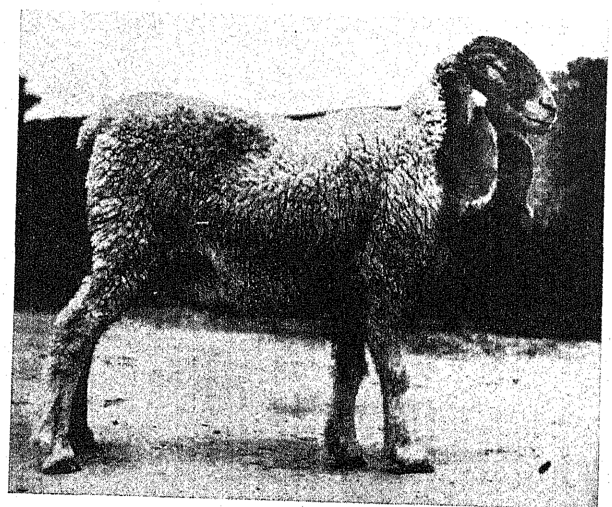


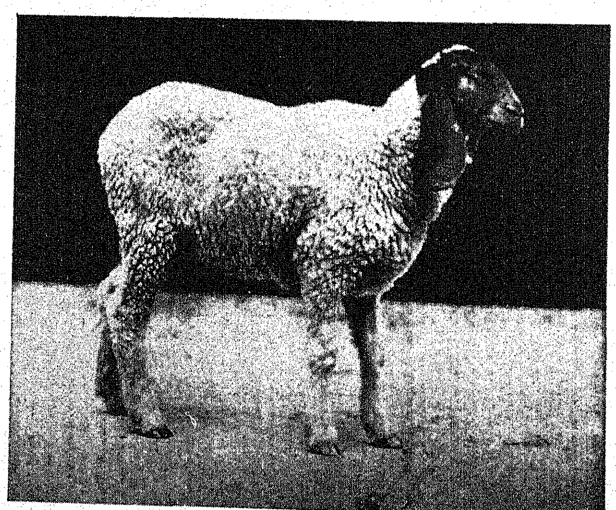
Ram



Ewe


Ram


Ewe

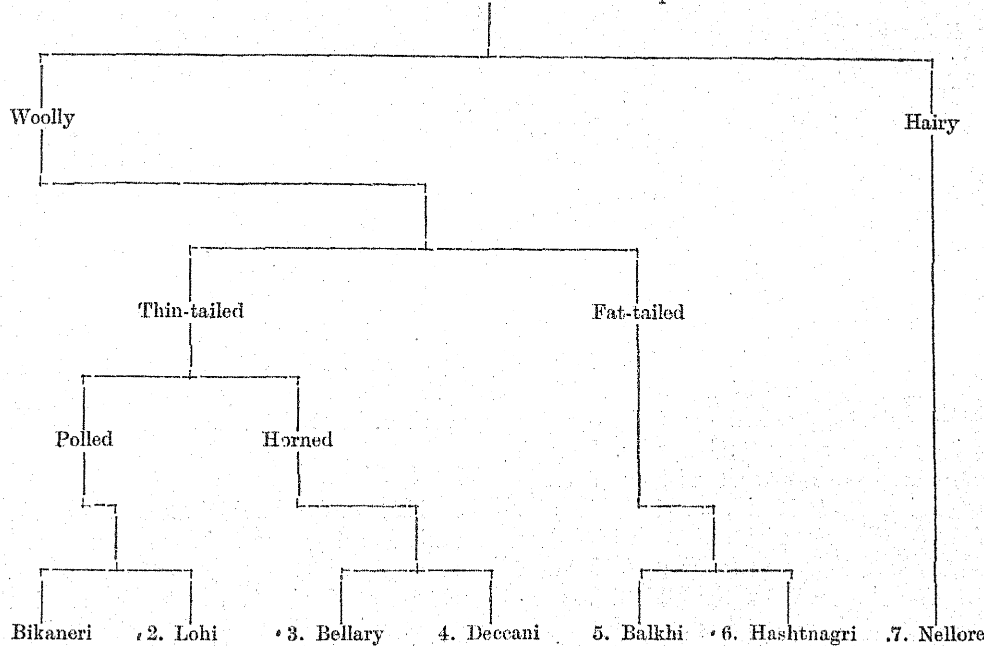

Lamb (10 months)

SOME COMMON BREEDS OF INDIAN SHEEP*

By R. L. Kaura, B.V.Sc., M.R.C.V.S.

Assistant Animal Husbandry Commissioner with the Government of India

Classification of Indian breeds of sheep



THE Indian breeds of sheep can be classified into woolly or hairy, thin-tailed or fat-tailed and polled or horned as shown in the table.

The hairy type of sheep is usually maintained for mutton, manure and skin but the woolly types are kept for the production of wool as well. Some of the latter are said to produce the best carpet wool in the world while other breeds produce a finer wool which is used in the blanket and hosiery trades. Sheep are owned generally by the poorer classes of people and certain nomadic tribes who migrate from place to place according to season and availability of grazing. Stubbles in the fields after the harvesting of crops are offered free of cost by farmers to the owners of flocks in return for the manure obtained by folding the flocks on their land. On the hills shepherds use their sheep as pack animals as well. The capacity of sheep for milk is estimated to be much less than that of the goat and generally sufficient only for its lambs; but certain breeds like the Lohi, the Balkhi and the Hashtnagri are well known for their milk yield which in the Lohi may reach as much as 8 lb. per day.

The sheep industry in India is now receiving greater attention from Government departments and efforts are being made to improve the quality and quantity of the wool of some of the recognized breeds by selective breeding and proper feeding and management. At certain places attempts have also been made

*Some of the information given in this article as well as photographs have been kindly supplied by Messrs E. J. Bruen, R. W. Littlewood, P. N. Nanda and S. M. Sarwar.

to improve the quality of wool by crossing with the Merino, and at the Hissar Farm a breed known as the Hissar Dale has been evolved and fixed by crossing the Merino with the Bikaneri.

For body measurements, weights and quantity of wool produced per head per annum, the table given at the end of this article may be referred to.

The Bikaneri ✓

Habitat and distribution. The home of this breed is the dry desert of Bikaner State, but it has extended in pure and impure forms to Hissar, Rohtak, Gurgaon, Ambala, parts of Ferozepore and Ludhiana districts of the Punjab and Patiala and Bahawalpur States. The lack of proper transport facilities in its home tract has kept this breed true to type for generations. There, flocks are reared under true ranching conditions, while in the Punjab flocks are grazed both in the *barani* (non-irrigated) and irrigated cultivated areas. These sheep are very hardy and can resist drought conditions even in severe famine years. Though belonging to a plains tract with an average annual rainfall of 14 in. or less, it also flourishes in places of high altitude with heavy rainfall such as Shillong (Assam). This breed has also been imported by the United Provinces, Central Provinces and Madras.

General description. It is a medium-sized sheep having a comparatively small head and stumpy tubular ears. The face is long, devoid of wool, Roman-nosed, more so in the male, and may be white, tan, dark tan or even black in colour. The colour may extend over the whole face or be limited round the eyes. The body is compact and usually grows white wool, occasionally showing black, red or intermediary coloured spots on quarters, sides and legs, in the local flocks. The eyes are bright and prominent and horns are absent in both sexes. The tail is of medium length and the hind legs are often cow-hocked. Hoofs are usually black in the dark-faced sheep and white in tan-faced and white-faced sheep (Plate 46.)

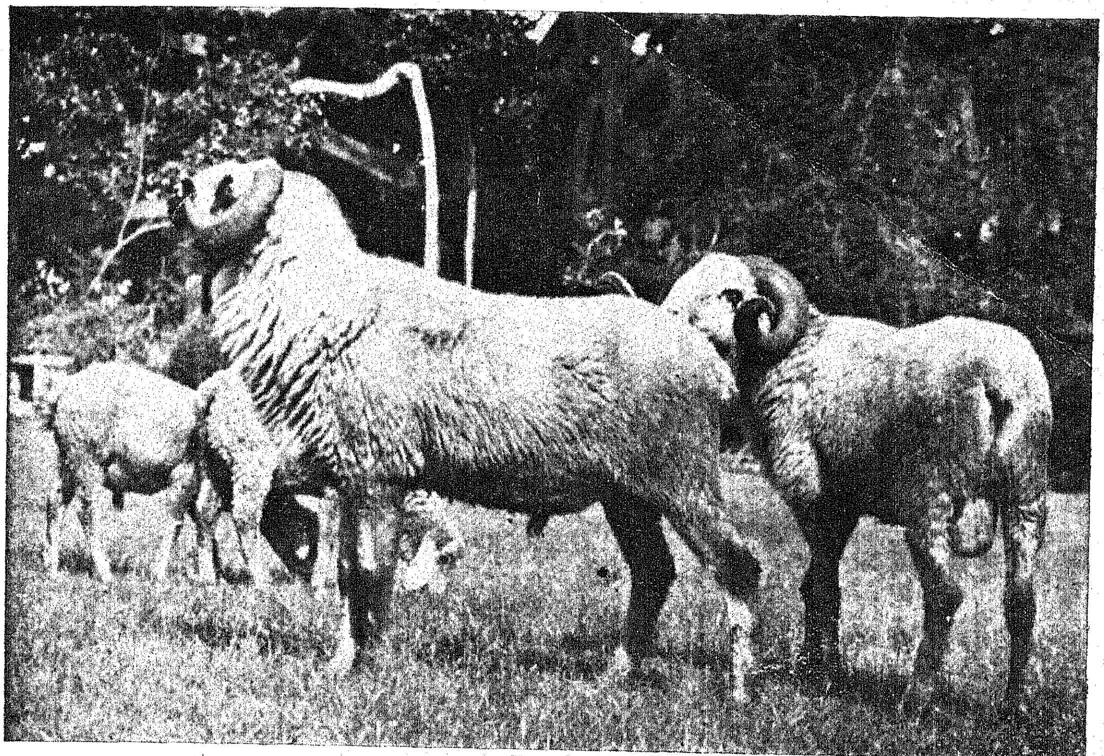
Wool. The wool is long and coarse, with considerable uniformity of fibres which are a little dry and brittle. The percentage of kemp is very small. It is most suited for the manufacture of carpets and is in great demand. Generally the summer clip is yellow in colour, while the winter is less so. The staple length in 6 months' growth varies from 3·5 to 5·5 in. The average quality varies from 28s to 32s and the spinning quality is 100 counts. The greater part of the wool produced in this country is exported to England and America and only a small proportion is utilized locally. It is made use of chiefly in the manufacture of carpets, in blends for blankets and rough type of tweeds.

Other qualities. These sheep do not fatten quickly and their mutton is of average quality. At the farms, the ewes are bred from once a year and breeding from them is started at the age of 15 to 18 months. Some village flocks are bred from twice a year and the ram is allowed to run with the ewes all the year round. The fertility percentage varies from 75 per cent in the village flocks to 90 per cent on the farms. Usually one lamb is dropped at a time, but twins are not uncommon.

The Lohi ✓

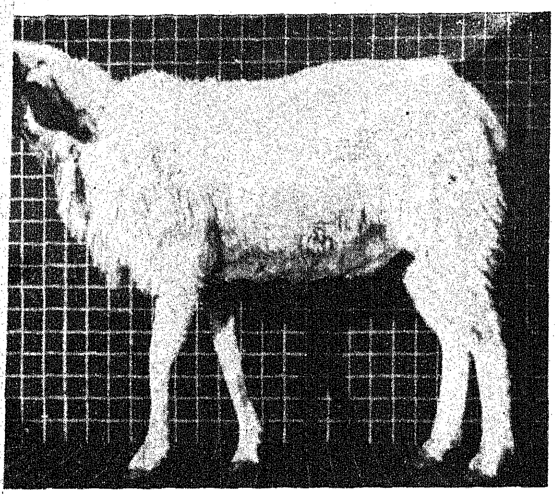
Habitat and distribution. Pure specimens of this breed are seen in the Multan, Montgomery, Lyallpur, Jhang, Mianwali, Muzaffargarh, Dera Ghazi Khan and Shahpur districts of the Punjab. In less pure forms, it is found in the adjoining districts of Gujranwala, Gujrat, Ferozepore, Lahore, Amritsar and Sheikhupura. In its home tracts, the flocks are kept either on the culturable lands where they are usually grazed on the stubbles and fallow lands or on the Thal desert tract where they graze on grasses, weeds and bushes.

General description. The animals have a large-sized white body, which is deep and voluminous, and a big heavy head of reddish brown, dark brown or black colour. Brown and black spots may occasionally be present on the body. The face is devoid of wool and is typically Roman-nosed. The ears are very long and drooping and sometimes trail on the ground when the animal is grazing. The ears generally carry a small cartilaginous appendage, known as *pharkani*, which is embellished with a tuft of hairs. The forehead is broad and strong. Horns are absent in both the

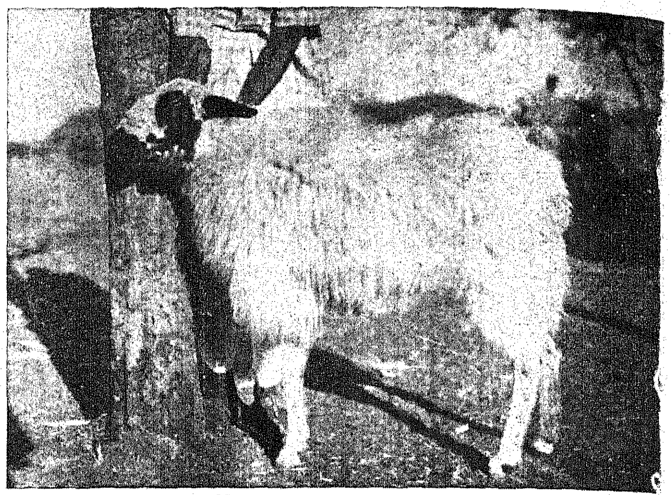


Rams

Ewes and lambs
(Note white ewes with black face and entire black ewes)



Ram (farm bred)



Ewe (farm bred)

ECCANI SHEEP

Ewe (black—village flock)

Ram (village flock)

Ewe (village flock)

[PLATE 49

sexes. They, however, sometimes appear in less pure types. The legs are strong, with hard black hoofs. The quarters are well developed and muscular. It has well-developed brisket, legs and back. The udder in the ewes is well shaped and carries long teats. The tail is short, thick and stumpy (Plate 47).

Wool. The wool is long, coarse, dry and of carpet type with admixture of kemp. The staple length varies from 3 to 4 in. It can be easily worked on the country-made hand spinning wheel and a considerable quantity is used in manufacturing rough cloth and blankets for the Punjab peasant.

Other qualities. Strong bone, well developed compact muscular body and the superb constitution of this breed render it a valuable mutton type of sheep. It responds to stall-feeding and fattens quickly. This breed is also well known for its milk which is very rich in fat and is sold after mixing with cow's and buffalo's milk or used for the production of ghee. The milk yield of some ewes is said to be as high as 8 lb. per day. Ewes are regular breeders and twins are common.

The Bellary

Habitat and distribution. Large numbers of these sheep are found in the talukas of Bellary district and Koilkuntla, Kurnool and Nandikotkur talukas of Kurnool district of the Madras Province. These sheep are owned by shepherds in the villages, each having on an average about 100 sheep. They are penned in the open fields or vacant land adjoining the villages and live on the shrubs and grasses found on the outskirts of villages or on the hills nearby.

General description. The Bellary is really a mixed breed. The usual colours met with are black, dark grey, white with black face, and black with white patches. The prevailing colour is black. When white sheep with black face are mated together about 55 per cent of the lambs are white with black face, 35 per cent are pure black and 10 per cent are pure white. White lambs are weak, small and difficult to rear, and are considered more delicate than the black variety by the shepherds. Their body is square and compact, the ribs fairly well sprung and the chest deep. Rams have twisted horns and the ewes are hornless (Plate 48).

Wool. Their wool is very coarse and straight. It may be black, white or grey. About 50 per cent of the wool is used locally for the manufacture of blankets.

Other qualities. These sheep do not fatten well and their mutton is of average quality.

The Deccani

Habitat and distribution. The home of this breed is a part of southern India known as the Deccan, the major portion of which lies in the Bombay Province. It is an arid country with an annual rainfall varying from 15 to 30 in. and consists largely of a moderately high plateau. The shepherd in this area is a nomad and, except for the monsoon season from June to September when the sheep are on the grasslands, he relies on weeds on the fallow of the cultivated area for the sustenance of his sheep. The tussock grasses in better soils, however, yield grazing up to December.

General description. Although this breed is classed an independent breed, for want of previous efforts towards improvement, the general appearance of these animals lacks the stamp of purity. Their colour may be black, white with black face or black patches elsewhere or all white. An all-white sheep having pink skin and carroty hoofs is considered a weakling. Black colour in the fleece corresponds with a dark skin and black hoofs. A white sheep with a black patch or black face is generally selected for breeding purposes and such an animal always has strong black hoofs. This breed has a thin neck, a narrow chest, prominent spinal processes, raised withers, flat ribs, a drooping croup and poor leg of mutton. The face is narrow with a decidedly Roman nose, ending in a narrow muzzle with peculiar depressed nostrils. Rams are generally horned but polled types are not uncommon. Ewes are hornless but occasionally a ewe carrying scurs is met with. The ears are short or medium in length, while the tail is very short with an average length of about $3\frac{1}{2}$ in. (Plate 49).

Wool. The fleece consists of a mixture of wool fibres and hairs in varying proportions. The wool is on the whole classed as a low-grade

wool. The dominant colour of the fleece is black, which degenerates into grey and roan as the sheep age. The wool is mostly consumed in the villages for the manufacture of rough blankets called *kumblies*. The little that is purchased by the mills is utilized for making a rough military type of blanket.

Other qualities. This breed cannot be classed as a mutton type.

The Balkhi

Habitat and distribution. Pure specimens of this breed are found in Russian Turkestan and North-west Afghanistan. In less pure forms they are found in the North-West Frontier Province and the tribal territories between Afghanistan and the North-West Frontier Province where they are brought by the Ghilzai nomads during the months of September and October and are purchased by the local people. There is no regular farm either in Afghanistan or in the North-West Frontier Province where systematic breeding is done. Indiscriminate cross-breeding with the indigenous sheep carried out by the nomads and the people of the North-West Frontier Province has resulted in considerable dilution of the Balkhi blood.

General description. It is a heavy fat-tailed variety of sheep. The colour is mostly black or grey with admixture of white and brown. The face is distinctly Roman-nosed, body round and compact, muscles very well developed, tail short, extending half-way down to the hocks, ears of medium length and horns either rudimentary or short and curved (Plate 50).

Wool. Wool is curly in the lamb and becomes coarse and straight with age. It consists of wool, kemp and heterotypical fibres. In Afghanistan it is used for making carpets, caps, cloths, overcoats, ropes, sweaters, blankets, etc. In the North-West Frontier Province cloth, stockings, ropes, *chughas* (long coats), etc. are manufactured from it.

Other qualities. This breed is not good for mutton which is poor in fat and fibrous in character. The animals breed regularly and usually lamb once a year during the months of March and April. A ewe of this breed yields 2-4 lb. of milk per day.

The Hashtnagri

Habitat and distribution. Pure specimens of this breed are found in south-east Afghanistan, Peshawar and Mardan districts of the North-West Frontier Province, the tribal territories in between and the adjacent parts of the Punjab. In less pure forms it is distributed in all the districts of the North-West Frontier Province and the adjoining districts of the Punjab. Though in certain places cross-breeding with the Balkhi and the local breeds of sheep has been done, pure specimens of this breed are found in very large numbers in the North-West Frontier Province.

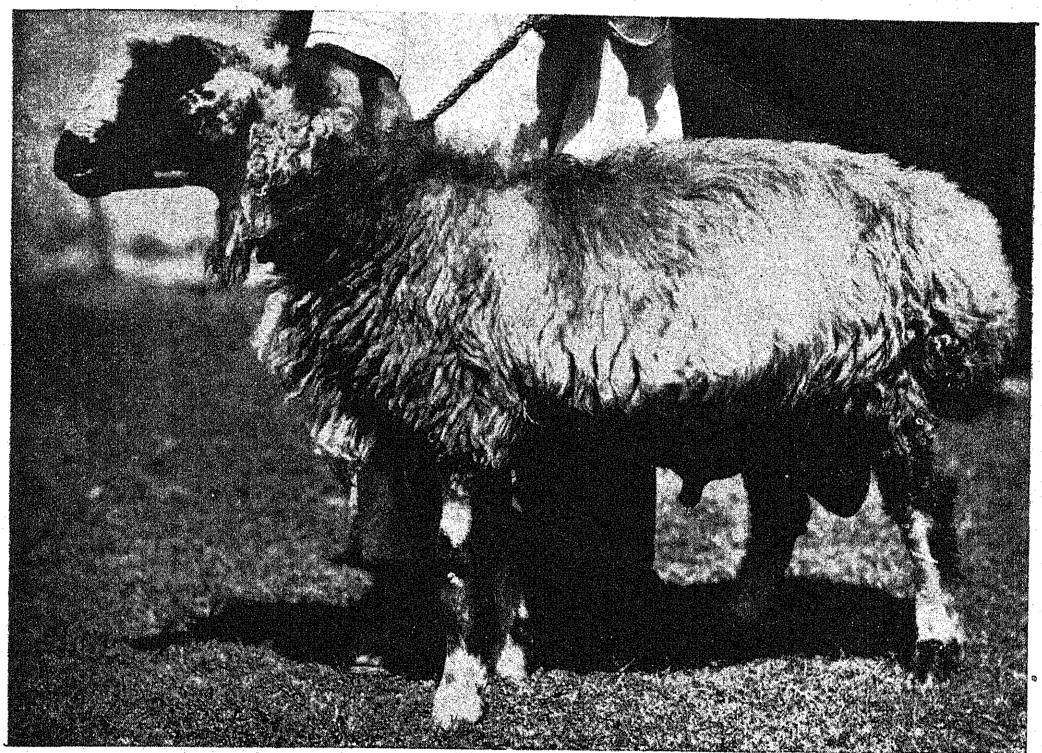
General description. It is a medium-sized sheep of white colour, with head partially or wholly black, face straight or slightly Roman-nosed, legs short and body compact. Fatty tail extends to hocks or even a little lower, and horns are rudimentary (Plate 51).

Wool. Wool is generally coarse and long, but a certain proportion of fine fibres are also present. It is used for the same purposes as the Balkhi wool.

Other qualities. It is one of the best mutton breeds and is very much appreciated by the butchers. Its short legs, compact body, broad chest and fully covered loins conform closely to an ideal type of mutton sheep. Besides, it contains plenty of fat in the tail, which is very much valued by the people of the North-West Frontier Province as they use it as a substitute for ghee. These animals breed regularly and lamb only once a year, usually during the months of March and April. A ewe of this breed yields 1-2 lb. of milk per day.

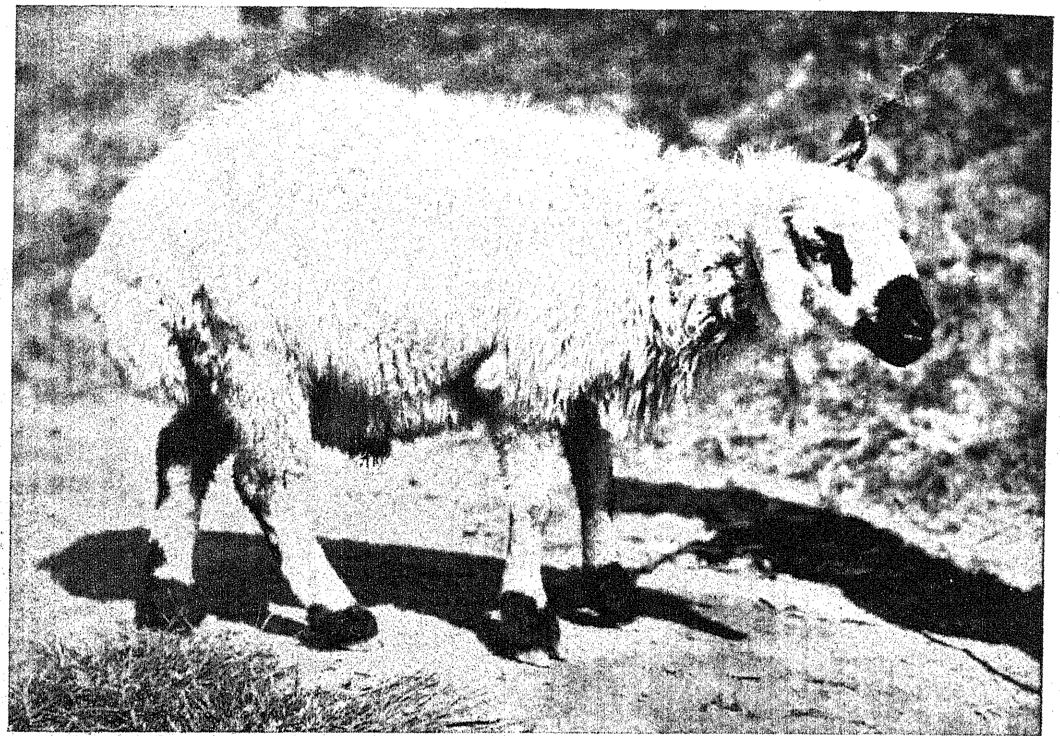
The Nellore

Habitat and distribution. This breed derives its name from its home, the Nellore district, which is on the north-east coast of the Madras Province, but it is distributed all over the Peninsula. In the southern part of the province the chief breeding centres are Paramakudi and Madukulathur talukas of Ramnad district and Thattapalai, Kasturirangapuram, Alangulam, Aruppukottai, Ettayapuram areas in Tinnevelly district. These sheep are reared on both black and red soil areas. They graze in the jungle areas, river beds, hill slopes and cultivated fields after harvesting of crops.

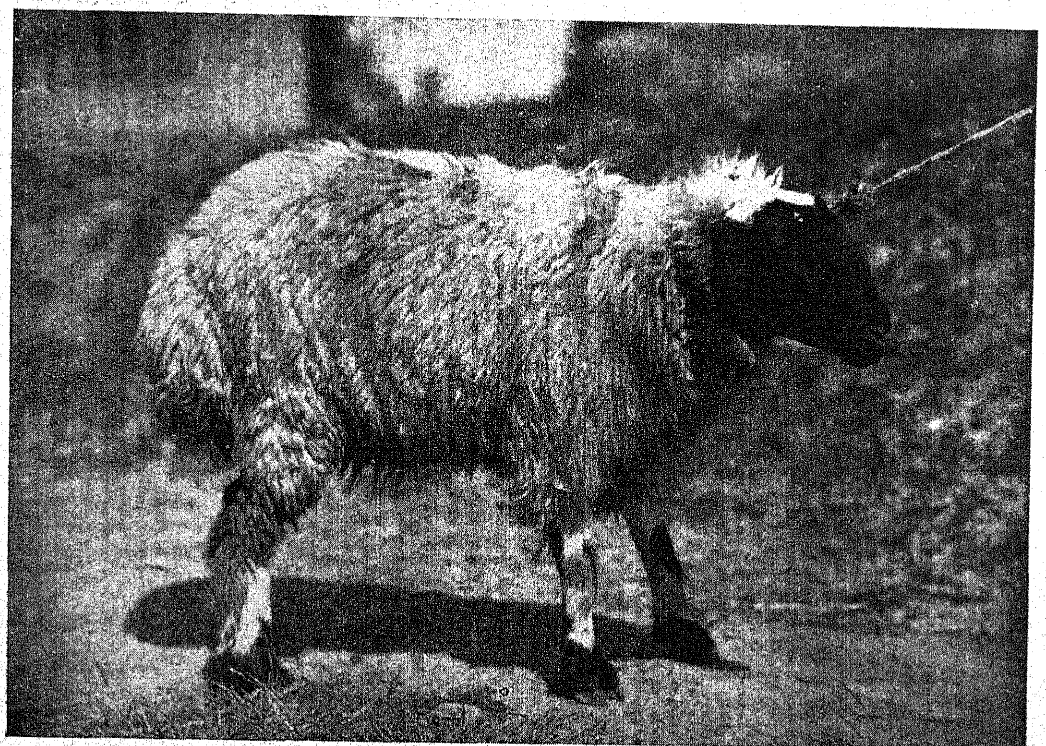


Ram

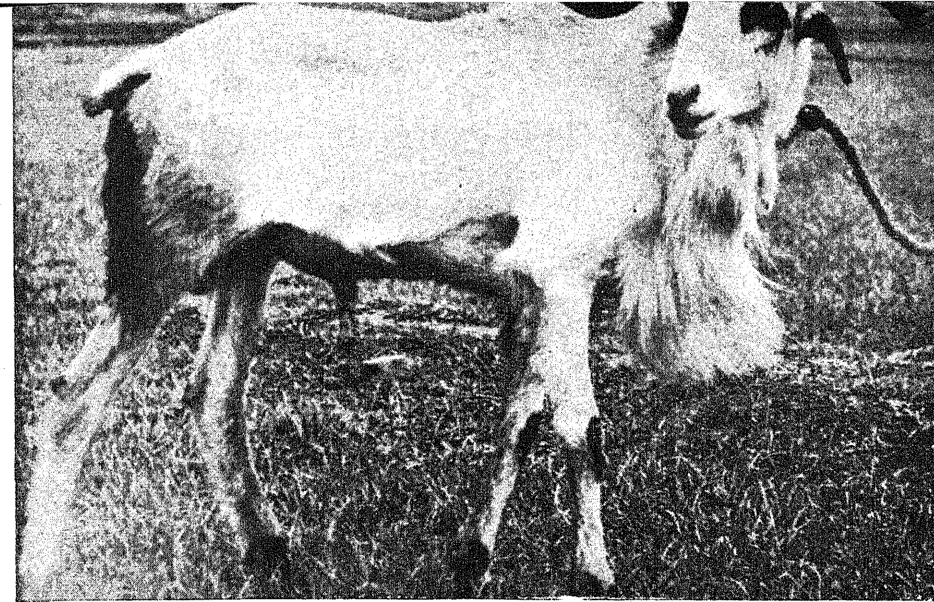
Lamb (5 months)



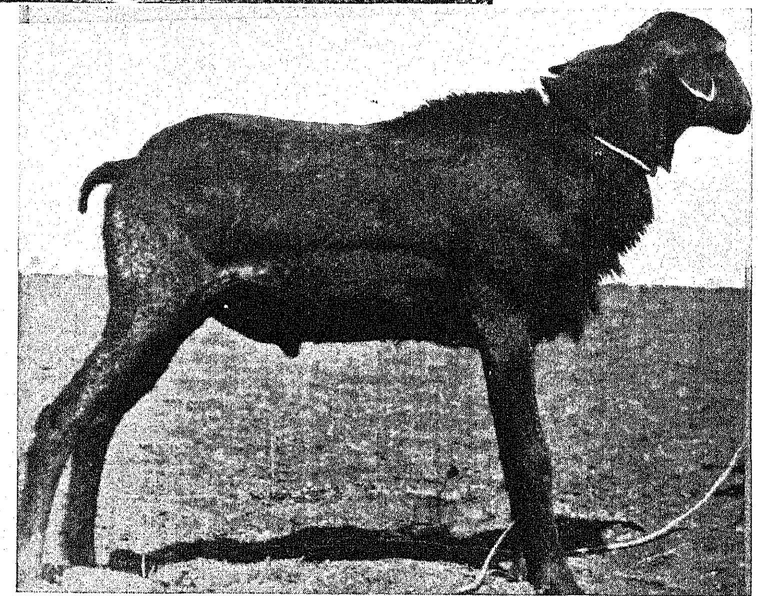
Ram



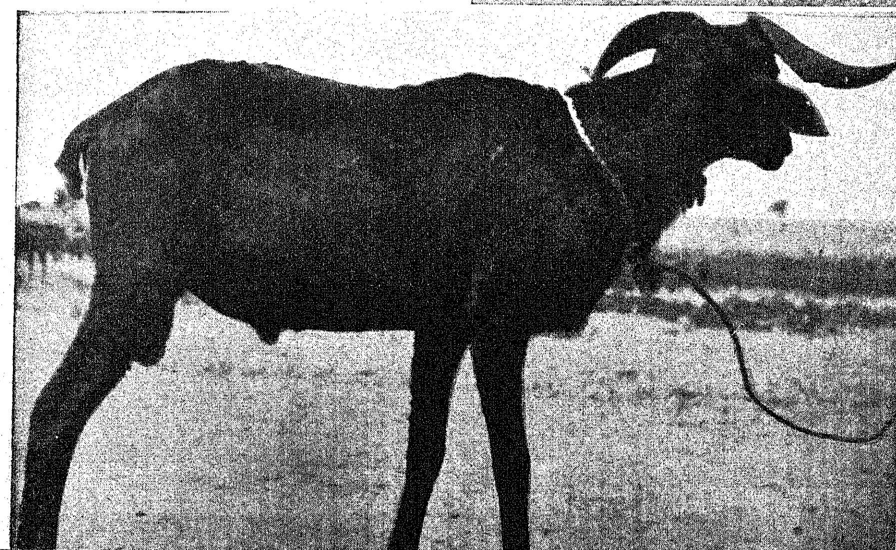
Ewe



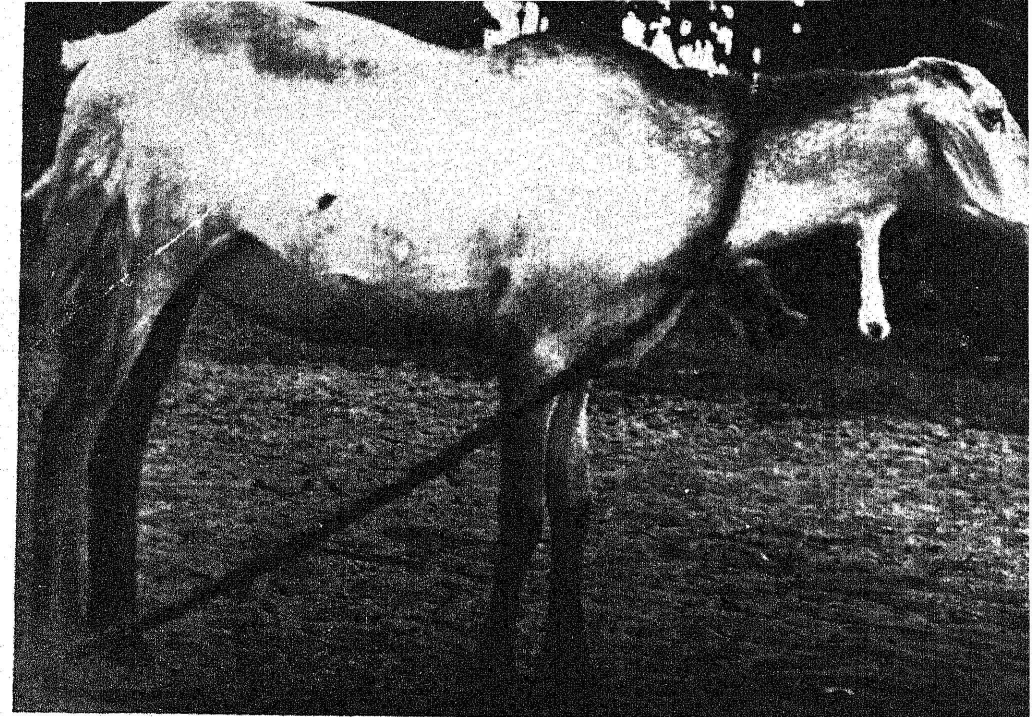
Left—White ram



Right—Polled red ram

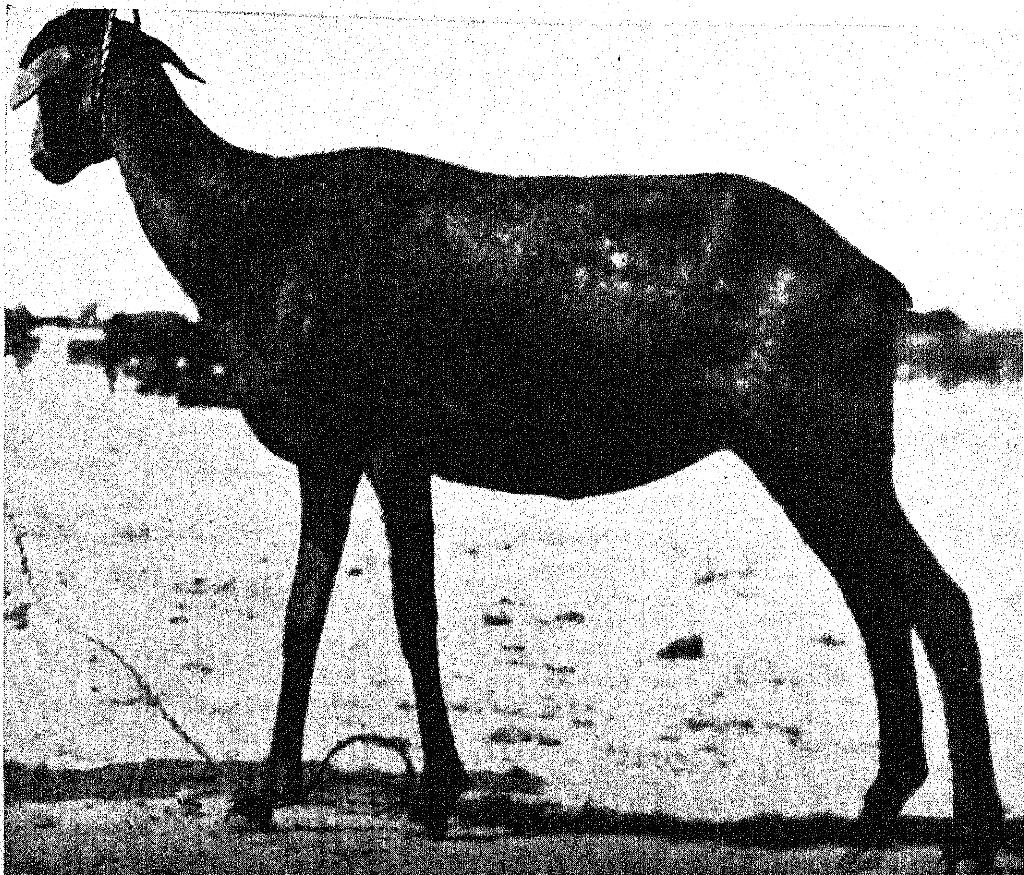


Left—Horned red ram



White ewe

NELLORE SHEEP



Red ewe

General description. They are large, well-built sheep of a hairy type and are said to be about the tallest in India. In the northern part of the province they are usually white or white with black or fawn markings on head, belly, legs, etc. Animals of light fawn colour or white with a fawn-coloured marking down the centre of the back and on the thighs and some of light red colour are also met with. Their body is densely covered with short hair. They have a long face and long ears and may show the two appendages of skin which are often seen hanging from the throat of goats in India. The rams have twisted horns and the ewes are hornless (Plates 52 & 53). As one goes towards the southern part of the province the animals are found to be smaller in size, somewhat lighter in weight, and mostly red in colour, but red sheep with white spots and patches under the thigh and the abdomen are also seen. Amongst these animals polled rams are more common.

Other qualities. Ewes take the ram for the first time when about 1-1½ years old. Rams start breeding when about 1 to 1½ years old, depending upon their size. Ewes are said to lamb once every nine months and twin lambs are very rare. In order to fatten male lambs they are fed on groundnut stalks, *dal* husk, *babool* (*Acacia arabica*) pods, a little groundnut cake and cotton seed and they are sold to the butchers when they are about one year old. Ewes are generally sold after five or six lambings. The breed is looked upon as a producer of good mutton. They are generally penned at night on arable land for manurial purposes.

Body measurements, weight, and wool production of some common breeds of Indian sheep

Breed of sheep		Average height at withers in inches	Average length from point of shoulder to point of pin bone in inches	Average girth in inches	Average body weight in lb.	Average yield of wool per head from two clips per year in lb.
Bikaneri	R	28·5	28·75	37·0	140	6·8
	E	24·75	23·75	31·75	80	2·8
Lohi	R	31·3	30·5	42·0	153	4·9
	E	26·5	24·5	34·8	81·4	3·1
Bellary	R	28	29-30	35	100-120	Village sheep =1·5-2
	E	26	26-27	31	70-80	Farm bred sheep =3
Deccani		21-25	22-27	28-32	R 70-80	0·75
					E 45-55	(0·5-2)
Balkhi		30	24	36	80-160	4 (2-6)
Hashtnagri		26	20	30	40-100	3 (1·5-4)
Nellore	R	30	28	34	90	..
	E	29	27	32·5	83	..

(R=ram, E=ewe)

PLANT HORMONES

By W. W. Mayne, B.Sc.

Coffee Scientific Officer, U. P. A. S. I., Balehonnur, Mysore State

THE processes of growth and development of living organisms have always been of absorbing interest both to the herdsman and farmer and to the philosopher and poet since the earliest times. Until the last century, little progress was made in understanding these complex processes, which were universally regarded as the result of the activity of a mysterious vital force not amenable to further simplification. The successful production in the laboratory of compounds formerly regarded as the result of the activity of this vital force and the rapid development of physical and chemical science in the nineteenth century brought a new point of view into the study of living things, a new hope that the phenomena of growth and development characteristic of life might be explicable in terms of physics and chemistry.

Fascinating chapter

Today, we have no illusions as to the complexity of the problem, but there can be no doubt that progress along many different lines is throwing gleams of light on the mechanism of growth and development. In one direction, investigations have extended beyond the field of pure biological research and have become of immediate practical interest to the farmer and fruit grower. These investigations are concerned with the existence of specific growth-regulating substances in plant tissues and they afford a fascinating chapter in the history of botany and its impact on horticulture and agriculture.

Everyone is familiar with the fact that if a growing plant is placed so that light reaches it only from one side, it bends towards the light. It was in the study of this common phenomenon that the existence of specific growth-regulating substances was proved and the basis of a new approach to many problems of growth was laid. The investigations were concerned in the first place with the reaction of the first leafy shoot, known as the coleoptile, of oat seedlings to one-sided illumination. This coleoptile is a hollow cylinder of tissue tapering to a bluntly rounded apex and it has proved a very suitable object for studies of this kind. It is beyond the scope of this article to go into details of the work done on this problem, but a description of one or two experiments is of great interest in tracing the broad outline of the discovery of growth-regulating substances or plant hormones.

Ingenious experiments

It was found by inserting opaque screens in various positions between the coleoptiles and the source of light so that either the tip alone or the base alone were illuminated, that although the growth changes occurred in the base, the perception of the light was primarily localized in the tip. Obviously some 'message' was transmitted from the tip to the base, which either checked growth on the lighted side or stimulated it on the dark side. The problem was the nature of the message; was it a stimulus like a nervous impulse conveyed by the living protoplasm or was it some definite substance diffusing down from the tip and influencing growth below?

The question was answered by an ingenious series of experiments which placed it beyond doubt that the stimulus was a definite substance diffusing down from the tip to the base. In the first place it was found that if the tip of a coleoptile was carefully cut off and then stuck on again with a little gelatin the coleoptile behaved towards one-sided illumination in exactly the same way as a normal uninjured one. Growth was influenced so that the shoot bent towards the light. This experiment made it clear that a break in the living protoplasm did not prevent the transmission of the stimulus; in other words transmission was

independent of the living substance. It seemed probable that the change in the distribution of growth was brought about by some substance which could diffuse through moist non-living material such as the gelatin which was used to fix the coleoptile tip.

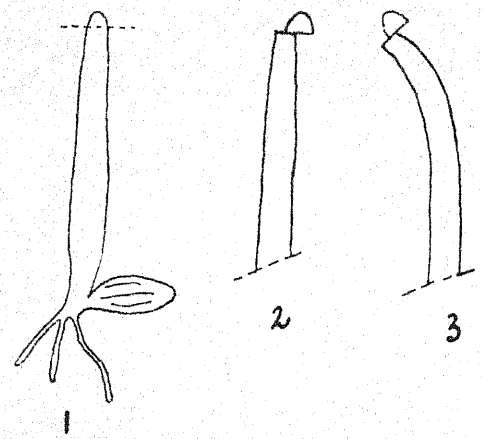


FIG. 1. Diagrammatic sketch of upper half of an oat coleoptile, indicating point at which tip is decapitated.

FIG. 2. The position of replacement of the decapitated coleoptile tip to illustrate the passage of growth-promoting substance down the coleoptile tip.

FIG. 3. The growth reaction obtained when the tip is replaced as shown in Fig. 2.

Growth substance

The next step was to show that the presence and action of this growth-promoting substance was not just a special instance due to the one-sided lighting. This was done by a very simple experiment in which the tip region of a coleoptile was carefully cut off and then replaced so that only one-half of the cut surface of the lower portion was covered by the replacement (Figs. 1 and 2). The coleoptile bent over in the same way as it would have done if it had been lighted on the uncovered side, i.e. the convex side was that over which the tip had been replaced (Fig. 3). This experiment is readily explained on the assumption that during growth the tip produces a continual supply of growth substance which stimulates growth on all sides. When the tip is removed and replaced in such a way that only one side can get a supply of this growth substance, then growth on that side is stimulated and the little shoot bends away from the stimulated side.

The next stage was an attempt to collect this growth substance. The tip of a coleoptile was carefully cut off and transferred to a small block of agar jelly and allowed to stand there for a short time. The tip was then removed and the block of jelly carefully placed on the cut surface of a freshly decapitated coleoptile so that the jelly covered only one-half of the cut surface. Again, the little shoot bent over in exactly the same way as it did when a coleoptile tip was replaced so as to cover only half the cut surface. The growth substance had diffused out of the coleoptile tip and been absorbed by the jelly, from which it diffused out into the decapitated coleoptile.

These experiments illustrate the main steps which led the investigators to the view that plants produce chemical substances which control growth processes. No other theory would fit the facts derived from many experiments of this type.

Chemical composition

The next step was the chemical investigation of the substance which caused these growth modifications. Unfortunately, the quantities which could be extracted from oat coleoptile tips were too small to permit this investigation ; so other sources were looked for. One was found in human urine, which was shown to act in the same way as the substance isolated in jelly blocks from oat coleoptile tips. From this source, three distinct chemical substances were isolated which showed the ability to promote growth. Two were new substances of considerable chemical complexity, but the third was a comparatively simple chemical compound, long known to chemists, which could be made in the laboratory. The first two were named auxin *a* and auxin *b*, while the third was a substance known as indole acetic acid. Further work has shown that a number of other substances chemically related to indole acetic acid also possess the power of promoting growth in varying degrees.

The discovery and isolation of substances capable of accelerating growth in oat coleoptiles

naturally led to the study of their distribution in other plants and to their effects on other forms of growth. The detection of the presence of such growth-promoting substances in many plants and plant parts makes it reasonably certain that they represent normal constituents of the plant organism and that they play an important part in growth and development.

Now, the term growth includes several processes which differ considerably in their characteristics. Growth may take place through the increase in size of the cells which are the units of which every organism is built up, or it may occur through the increase in the number of cells by division of pre-existing cells. In the latter case, the cells may retain the form of the parent cells, or they may be changed and grouped to form new structures such as roots, shoots, leaves or flowers.

The earlier work on growth substances was entirely concerned with the first type of growth but naturally investigators were not slow in studying their influence on other growth and developmental changes. Most of this work has been concerned with indole acetic acid and related substances which can be readily produced in the laboratory.

Practical application

Many methods have been used to apply growth-promoting substance to plants—dipping plants in dilute solutions, injecting dilute solution into plant parts or spraying or dusting plants with dilute solutions or dusts carrying small quantities of the substance under investigation. Active substances were found to cause various bendings and twistings of stems and leaves and also, in many cases, the production of young roots on treated areas of stems and other aerial parts. This initiation of roots immediately suggested the possibility of utilizing such active substances for encouraging the rooting of cuttings and what appeared at first to be a branch of academic research suddenly became of absorbing interest to the practical gardener and horticulturist.

Cuttings of many plants have been treated with dilute solutions of these synthetic growth substances. The results have varied enormously but in many cases improvements in the speed of rooting and in the proportion of cuttings successfully rooted have been obtained. Among the plants which have given successful results are several of considerable commercial importance, including rubber stumps and, in Kenya, coffee cuttings. Naturally, in the early stages disappointments and failures are only to be expected, but it is probable that with accumulated experience some early failures may be changed to successes. As compounds possessing the power of stimulating root initiation are readily procurable, a fascinating field of experiment is open to all enthusiastic horticulturists who are interested in plant propagation.

Function in plant life

The part played by these substances in normal development is still obscure and it seems that at present a distinction must be drawn between the auxins, which apparently are the growth-regulating substances normally present in the growing plant and produced by the plant itself, and substances such as indole acetic acid which are of external origin. In any case, the effects produced by either type of growth-regulating substance are to control or modify the utilization of the food reserves available in the plant or plant part. They may be likened to the animal hormones and vitamins which exert an influence on development out of all proportion to their quantity but can only act if supplies of energy-providing and body-building foods are adequate. The auxins are directly comparable to animal hormones as both are regulatory agents produced by the organism itself. Indole acetic acid may be likened to a vitamin, in that it is apparently not produced by the plant itself but can be absorbed from external sources.

It has been shown that synthetic growth substances can be absorbed by the roots from the soil and exert visible effects on the plant. The effects seem to range from stimulation of normal development through abnormal growth modifications such as aerial roots, etc. to definite toxic action, with increasing doses. It must be understood that the quantities of these substances which can be used without injury to the plant are very small.

There is still little knowledge concerning

the occurrence of these synthetic growth substances in nature, but it is known that indole acetic acid is produced by microbial action on proteins. This, together with the knowledge of its presence in urine, focusses attention on partially decayed organic matter and on composts as possible sources. It may be that some of the special effects of farmyard manure and composts that have been claimed from time to time may lie in their content of these growth-promoting or regulating compounds.

We are only on the threshold of knowledge of these remarkable compounds. But it is clear that they are intimately concerned with the characteristic controlled development of living organisms and further work cannot fail to throw more light on this central biological problem as well as on many questions of fundamental importance to agriculturists.

COTTON IN THE CHITTAGONG HILL TRACTS

By M. P. Singh, M.Sc.

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THE Chittagong hill tracts which form the eastern extremity of Bengal consist of several ranges of hills generally not more than 300 ft. above sea-level, though they rise in some places to 2,000 ft. and over. The hills are mainly of sandstone origin and are covered with a variety of forest trees, and in the unclassed state forests which are not reserved there is much mixed jungle. The hills are traversed by several streams which are the main means of transport; otherwise the tract is devoid of adequate means of communication. The inhabitants are indigenous tribes of Arakanese, i.e. Chakmas, Moghs, and Tripuras. Besides agriculture and bamboo-cutting these tribes have little occupation. Their agricultural practices are peculiar, as they practise mixed cropping on the hill slopes in a very queer way. The crops cultivated are paddy, cotton, *til* (sesamum) and cucurbitatious seeds. Mustards and pulses, especially lentils, are also grown on the river banks. In the valley lands, which are by far the most fertile spots, paddy is grown.

Importance of the tract

Botanically the hill tracts have great importance, being considered either a primary or secondary centre of distribution of the cottons both of the Ganges basin and central India. They are said to have given rise to the coarse cottons of the northern sections of the Chinese crop as well. Hutchinson, in 'The Distribution of Gossypium and Evolution of Commercial Cottons', a paper read at the conference of scientific research workers on cotton at Bombay (1937), has emphasized the botanical importance of Bengal and Assam, and it is from his work that the above conclusions have been drawn. Besides the considerations regarding the centre of distribution, the hill tracts are important in another respect, viz. that of growing a special type of cotton. The characteristics of this cotton are long bolls, with long bracteoles completely enclosing the bolls, long petioles, and a very high ginning percentage. The lint of this cotton twists badly and has a harsh feel. The staple is short and the cottons are used mainly for mixing with wool. The high ginning percentage averaging 43 per cent in these cottons alone is sufficient to make the hill tracts an important cotton-growing area, apart from the considerable output sold in the market annually. The total production of cotton has averaged 200,000 maunds during the last five years, and the ruling price was about Rs. 6 per maund. The export of these cottons during 1932-35 was as follows:

Year	Tons
1932-33	1,785
1933-34	2,780
1934-35	2,991

The increasing demand for these cottons, the considerable production, and the high ginning percentage indicate the importance of the hill tracts.

Recognizing the importance of the hill tracts, the Indian Central Cotton Committee suggested a survey of the cottons growing there with a view to standardizing the ginning percentage, and supplying the hillmen with a type of cotton which would give him a better monetary return, especially when the quality of these cottons had come to be recognized by the trade. The figures received by the Hill Officer's Conference held on 19 July 1937 to discuss the marketing of the hill produce are sufficient. The latest maximum prices received by the grower were reported to be as follows:

	Per maund of *kapas* Rs.
Garo hills	12-0-0
Lushai hills	7-0-0
Chittagong hill tracts	7-0-0
North Cachar hills	6-8-0

The cottons of the Garo hills are reputed to be very coarse and they therefore command a premium in the market. The information reported here is the result of the survey of the Chittagong hill tracts made in 1937.

Agricultural features

The chief agricultural features of the tract are heavy rainfall which averages 95 in. a year, the greater bulk of the precipitation being during the months May to September. The practice of cultivating the hill slopes affords a good drainage. The cold weather which sets in the hill tracts in the month of October is fairly intense and definitely sets an anterior limit to the growth of the plant. During the hot weather there is practically no rainfall, and the length of the growing season is thus only about 160 days, i.e. from May to September.

Towards the end of January and in February the hillmen cut the jungles on the hill slopes and when the clearings have dried up by March and April, they are set on fire and burnt, and the resultant ash is the sole manure which the hill slopes (*jhums*) receive. With the onset of the rains the hillmen, with the help of a hoe called *dao*, dibble in a mixture of paddy, cotton, *til* and cucurbitatious seeds. As the monsoon progresses the seeds germinate in turn, and are harvested as they ripen. When he has finished with one hill slope, the *jhumia* (the man who plants a *jhum*) seldom returns to it within three or five years, for he is aware that if the same hill slope is used again without giving it a proper rest, a satisfactory outturn will not be obtained. Hence new hill slopes are sought for. The hill slopes which have bamboo in abundance are generally preferred, for it is easier to cut and burn them. Where no bamboo hill slope is available advantage is taken of the mixed jungle and thatching grass slopes, but these are considered to be less productive as compared to the bamboo slopes. Slopes having a good deal of clay are preferred to the sandy slopes. Following the example of Bengalis and encouraged by the Agricultural Department, some of the hillmen cultivate the river banks and sow *rabi* crops and vegetables ; otherwise their one and only source of agricultural produce is the *jhums*. The increasing population is making good *jhum* lands scarce, the prosperity of the *jhumia* is declining ; and his living is becoming more and more precarious.

Cotton production

Cotton is sown in mixture with other crops and remains stunted till the paddy is harvested. It then grows quickly, but is sometimes covered by cucurbitatious plants which twine themselves around it. During the vegetative period of the crop women go about with their *daos* and do a little weeding twice or thrice, to cut down the vegetation and to encourage the sprouting of bamboo shoots. With the end of the monsoon the cotton in the *jhum* becomes ready for picking, and in the second picking even the green bolls are picked, and are dried at home and the *kapas* (cotton) taken out by breaking them.

Jhums are cultivated by families which vary in size, and as it is the family alone which is taxed and not the acreage, it is very difficult to ascertain the actual area under cotton. Taking the average *jhum* as three acres, there are probably upwards of 90,000 acres under cotton distributed as follows.

	Acres
Chakma circle	36,000
Bohmong circle	30,000
Mong circle	24,000
TOTAL	90,000

It is estimated that more than 200,000 maunds of cotton are exported from the hill tracts each year. The figure is probably below the actual, for a good *jhum* can yield more than two maunds of *kapas* per acre.

Interested hillmen generally practise a sort of mass selection by way of keeping the first picking locally known as '*phool kapas*' for seed purposes. Those who are heavily indebted or are uninterested dispose of their produce just after it is ready and buy seeds from the markets which are replenished by the Chittagong ginneries dealing in bulk with the produce of the hill tracts.

A part of the cotton thus produced is consumed locally in preparing the clothes of the hill people, and hand-woven bed sheets of coarse yarn spun at home by means of a *charkha* (spinning wheel). The greater bulk of

the produce, however, is sold in the form of *kapas* either to petty traders who visit the hills during the harvest season, or to more or less permanently settled *banias* who advance loans to the hillmen during the sowing season. The produce thus collected from the hillmen is pooled at Chittagong and ginned. The seeds are again sold in the hills and the lint exported to foreign countries like Japan, Scandinavia, Germany, America and the United Kingdom.

Cotton survey

A survey of the hill tracts was made in 1937. The method was to sample the hill slopes every five miles wherever the places were accessible by road. The hill slope nearest the milestone was entered and samples varying from 20 to 100 plants depending upon the size of the hill slope sampled were collected from a portion of the hill slope taken at random. Wherever the places were accessible by river, hill slopes within the radius of five miles were concentrated upon and the material collected as aforesaid. The material thus collected was examined for feel, staple length and ginning percentage.

The cottons grown in the hill tracts are both the narrow and broad-leaved white and yellow flowered types of *Gossypium cernum*. Exact proportions of the different forms present cannot be given as leaf and flower counts were not taken. Both the brown and white linted types are found in the *jhums*. The frequency of brown linted types is not considerable, though at times in some of the *jhums* brown linted types were met with in considerable proportions. Brown linted types have been described as *G. Cernum* var. *sylhetense*.

Throughout the tract rough linted types are dominant. There were some smooth linted types too, but their number was not considerable. The samples collected in the survey were classified for rough and smooth feel for each circle, and it will be seen from the figures below that the highest percentage of smooth linted forms is from Bohmong circle.

Circle	*Rough*	*Smooth*	*Percentage*
Chakma	394	62	13·6
Bohmong	366	60	14·3
Mong	350	31	8·1
TOTAL	1,110	153	

In the hill tracts short linted forms were found to be in excess of the long linted forms which are quite rare. The staple length ranges from 12 to 25 mm. and most of the samples fell between 15 to 21 mm. The average staple length of the hill tracts material is 17 mm. From the mean staple length of each circle of the hill tracts given below it will be seen that Bohmong circle has the longest linted forms.

Circle	*Mean in mm.*
Chakma	17·91
Bohmong	18·81
Mong	17·22

The ginning percentage in the hill tracts was found to be greatly variable. Three types of cottons so far as ginning percentage is concerned are met with: (1) low ginning, (2) medium ginning, and (3) high ginning types. The ginning percentage in the hill tracts material varies from 23 to 57 per cent with the maximum frequency at 44 per cent. The mean ginning percentage is 43 per cent.

Circle	*Mean ginning percentage*
Chakma	42·55
Bohmong	41·90
Mong	43·02

From the above means of the different circles, it will be seen that the highest ginning percentage is of the cottons of the Mong circle.

Problems

From the export figures it is evident that there is a market for the cottons grown in the hill tracts. The immediate problem which presents itself is that of isolating a type which is high-yielding, and which could give a higher money return to the cultivator. As the cottons of these parts are not suitable for spinning purposes, being too short and coarse, the consideration should be given to ginning percentage. It is not the staple length which is wanted under existing conditions, but a high ginning percentage, which would add to the *jhumia's* income.

The high ginning and yielding type must be such as can stand competition with other three crops, viz. paddy, *til* and the cucurbitatious

plants. As it is grown on hill slopes, a pure crop of cotton may not be able to bind the soil firmly enough to prevent landslides, so it has to be grown mixed with other crops.

The cottons of the hill tracts are used for mixing with wool. A considerable premium is commanded by the coarser cottons of the Garo hills in the market. It is therefore desirable that the type selected should be coarse, besides being high ginning and high yielding. The estimate of coarseness which was up till now based upon hand and eye examination alone, and was thus liable to errors of personal judgement has been recently improved by Ahmad and Sen (Technological bulletin series B No. 18, 1933) who have shown that coarseness depends upon the wax content of a cotton, and that like phosphorus content, it is an inherited character, liable to be influenced by environment. They have also drawn up a scale for expressing the degree of silkiness of a cotton in terms of its wax content. It is therefore essential that the wax content of the type be determined before it is classified as rough and thus free it from the personal errors of judgement.

The climatic conditions under which cotton is grown in these hills impose a limit to the growing period. The limitations reduce the vegetative period to a maximum of 160 days. Sowings commence in May or early June before the regular monsoon sets in. The maximum crop may be expected when plants are in full boll, and the bolls start bursting soon after the end of the rains.

THE ROYAL AGRICULTURAL AND HORTICULTURAL SOCIETY OF INDIA

By S. Percy-Lancaster, F.L.S., F.R.H.S., M.R.A.S.

Secretary, The Royal Agri-Horticultural Society of India

THERE are not many institutions in this country that can look back to a century or more of service. The idea of a Society for the development of agriculture gradually took shape during the years Rev. Dr Carey spent among the ryots and was certainly discussed with friends prior to 1820 when his Prospectus was issued. This document resulted in a public meeting being called on the 14th September of that year to consider the formation of such a Society. It must have been a great disappointment that only seven gentlemen out of thirty-two who had promised help attended; but the keen supporters of the scheme decided to form 'The Agricultural Society'. At a subsequent meeting officers were duly appointed. The addition of the name 'Horticultural' took place shortly after the founding of the Society.

Objects

As set forth in the Prospectus, the objects of the Society were the promotion and improvement of agriculture and horticulture in all its branches in India and the Rev. Dr Carey hoped that by pooling their information and experience, every individual would be in possession of the sum total of knowledge thus acquired.

Gardens

Seven years after the Society was founded a small piece of land was provided by Government in Alipur, at the head of Budge Budge Road, for a garden, as well as a few *bigahs** in Akra where experiments in growing tobacco, sugarcane, etc. could be conducted. Both these plots had to be abandoned owing to the failure of Agencies in Calcutta and consequent financial loss to the Society. Unfortunately seven years' work had been put in on both these plots. In 1836 six *bigahs* of land were obtained at Sibpur alongside the Royal Botanic Gardens, which were gradually increased to 44 *bigahs* and by 1844 the area was 52 *bigahs*. Here fruit and flowering plants as well as economic products were grown, but this land had to be relinquished to Government in 1866. Till 1879 the Society was without a garden and then the waste lands to the south of Belvedere were made over to the Society by the Government, under certain conditions, and this is the present site of the Society's Garden at Alipur.

Pioneers

When Carey started the Society he found that the cereals, the vegetables and fruit of the country were of very poor quality, and immediately interested members in his scheme to import seeds from all parts of the world for free distribution. For instance, sugarcane from Mauritius and other sources was obtained and propagated for distribution. In the first and following few years of sugarcane cultivation we find that 34,000 sets were distributed every year. Cotton seed was purchased annually from America, and in 1838 we learn that Rs. 1,000 was set aside to get seed from South America, the West coast of Africa, China, Manila, etc. Tobacco seed of improved varieties was also obtained for distribution. Then, in regard to vegetables, perhaps it would not be far wrong to say that the acclimatized Patna cauliflower is the result of seed which the Society obtained from the Cape of Good Hope and passed on to local cultivators and that the famous Naini Tal and Shillong potatoes owe their origin to imported English strains. Fibres, tans, dyes, oils, fats, etc. were all items that the Society took up; various fodder crops such as Guinea grass, reana and lucerne first reached

* Indian measure of land, varying locally from ⅓ acre to 1 acre.

these shores through the agency of the Society. Annual introductions of maize from the United States of America and paddy from Carolina and New Granada are recorded, while in 1852 the Society drew attention to the great advantage of introducing the Cinchona to India. Tea was another subject that has called for much groundwork by the Society, and the valuable reports of Drs Griffith and McClelland will be found in the Transactions of the Society. The discovery of the indigenous tea plant in Cachar was reported by Capt. Verner, Superintendent of that district and printed in volume 9 of the Society's Journal.

The Society was able to enlist the services of keen members who willingly carried out experiments and communicated their results which were embodied in the Journals and Transactions. Where the Society did not actually introduce certain products, it can claim to have brought them very prominently to the notice of the Government.

How improvement was maintained

In 1821 a questionnaire issued to members of the Society and other keen gardeners in India raised 20 points about soil, climatic conditions, crops, etc. and the replies were published in the early Transactions.

The first of a series of awards and premia was offered in 1822 in the form of gold medals and cash bonuses of Rs. 100 for the introduction or improvement of coffee, cotton, indigenous fruit from the eastern islands, etc.

In 1827 essays were called for on many agricultural subjects and handsome premia awarded to the writers of the selected ones. It was decided by the Society about this time that seeds and plants should be obtained from abroad for distribution to members so that the quality of the vegetables grown in the country could be thus improved. In 1826 we learn that Rs. 500 worth of seed came from the Cape of Good Hope, N. S. Wales, and Europe for free distribution and the names of 76 Calcutta market growers and 48 from Patna who were the recipients of seeds are given in one of the Journals. A general selection of European varieties was distributed gratuitously to market gardeners for a period of 30 years till such time as it was considered that they were independent of extraneous aid.

Twenty pounds worth of seed potatoes and grains were also purchased from Van Diemen's Land and from England in 1826.

Exhibitions were of annual occurrence and generous prizes both in cash and medals offered for competition. In 1827, for instance, we learn that a certain Ramtunoo of Gobra won a silver medal and Rs. 40 for potatoes and a similar award for cauliflowers, while Haludhar carried off a like prize for peas but tied with Ramtunoo for cabbages. On the 16th January 1828, 109 *malis*, whose gardens, ranging in size from half a *bigah* to twenty *bighas*, and situated in Alipur, Bhuyudanga, Chundunnagar, Kamardunga, Bhookaklash, Kidderpore, Sonae, Guapore, Motijheel, Moochkola, etc. gathered for a competition.

In 1834 the first consignment of imported fruit trees reached India from Liverpool per *Princess Charlotte* and cost £100.

For the first 20 years of its existence members only received the Transactions and Journals of the Society telling of the experimental work carried out, and it was not till 1840 that a direct return on their money was given in the way of a packet of seeds and a few plants. These privileges have since been extended till at the present time the Society is one of the few institutions in the world, unsupported by Government aid, providing generous advantages in seeds, plants and literature.

It is interesting to note that attempts were made for a short period (1830-44) towards improvement of indigenous cattle, a schedule of prizes on a liberal scale was offered, but the shows were abandoned as competition was not sufficiently great.

Branch societies

Keen members started branches of the Society all over the country; the Lucknow branch appears to have been the first (1835), followed soon afterwards by those in western India, Madras and Dinapore. In 1836 mention is made in the Journals of working branches in Bangalore, Beerbhoom, Burdwan, Hooghly, Meerut and as far afield as Singapore.

Why agricultural ?

In its early years the Society practically did the work of the Agricultural Department. Experiments were conducted by its members in growing the staple products, cereals, etc. Gradually the demand for more detailed experiments in the cultivation of crops and the trials of fibres, etc. was called for and it was found impossible with the small staff and land at its disposal for the Society to cope with the work. In 1900 Lord Curzon acquired the Society's interest in Metcalfe Hall which had served as an office, economic museum and library for many years and at the same time relieved the Society of all agricultural work. Enquiries, however, are still constantly made to the Society on agricultural subjects.

Support and recognition

In times past the Government were very generous with grants in aid for premia and prizes and at the same time arranged for land for our many gardens at a nominal rent. With the withdrawal of all agricultural work an annual grant, which had been received since 1886, was stopped and from that date the Society stands as a self-supporting institution. No monetary assistance is received from the Government, municipality or other public body and the membership subscriptions and sales to the public provide the upkeep of the Alipur Gardens.

The Marquis and Marchioness of Hastings were the first patrons of the Society and since then the several Viceroys have successively honoured us with their patronage. The Lieutenant-Governors, and subsequently the Governors of Bengal, have been Vice-Patrons.

Membership

Our membership in 1820 was 35 but the numbers gradually went up as the work of the Society became known. Fluctuations are natural with a floating European population, but we are able to show over a thousand members on our books. Since the Great War and the altered conditions of life, the Society has introduced a 'B' Class membership with smaller subscription and carrying fewer privileges to suit members living in flats or small houses. 'A' Class membership is popular with mofussil gardeners.

In addition to the normal routine correspondence that takes place with members in India and abroad, the Society maintains a Free Enquiry Bureau on matters connected with horticulture. It will be readily understood that there are many who take advantage of this service.

A valuable library of over 2,000 volumes dealing with agri-horticulture in all its branches is open to members for consultation. Many of the books are out of print.

Publications

The issue of Transactions and Journals which embodied reports of experimental work made the publications of the Society very useful. Copious extracts from the Society's Journals and Proceedings will be found in the *Dictionary of Economic Products of India* and other official publications of the Government proving that the efforts of the Society have made a valuable contribution to the improvement of agriculture. For many years, however, no Journal has been issued, but an annual report and a monthly news sheet are published. A useful handbook for amateur gardeners, *An Amateur in an Indian Garden*, has been written by the Secretary of the Society, while *Tennis Courts in India*, a *Perpetual Gardening Calendar* and a leaflet, *How to Hybridize*, are issued by the Society.

Past work

Mention has been made of the attempts to improve the existing products of the country by the introduction of improved types, and while the economic side has been touched on we should not forget the fruit. Indigenous fruit still stands in need of improvement, but such work requires a specially trained staff and a large area to test cross-breeding results. There are more than 500 varieties of mangoes, some only cultivated in one province but worthy of greater notice. The Society introduced tropical and sub-tropical varieties of fruit in the early years of its existence and has continued to choose the best types as far

as hardiness and productiveness is concerned for distribution to its members. Grape fruit from Florida, pomelos from Java and seedless *lichi* from China have been lately introduced.

Horticultural

It is not only on the useful side of gardening that the Society has worked but by the introduction of new flowering trees, shrubs and climbers it has helped to make India beautiful. During the past half-century there has been an increasing desire for better gardens both among the Indian and European community and the old standards of plants have been discarded. The demand has been met by obtaining seeds and plants annually from all parts of the world and testing them at Alipur, before distribution.

The Society has also devoted much time to cross-breeding. The results have been highly successful.

Improved types of Canna, *Cooperanthes Hibiscus*, *Ixora*, *Lagerstrœmia* and *Plumeria*, to name a few, have been obtained and new varieties are being added every year. At the close of 1939 a Committee of eminent scientists in Calcutta was formed for the naming and registration of hybrids. Work is proceeding and a number of specimens have already been recorded.

The experimental annual garden at Alipur has been the means of bringing little-known varieties before the public and many novelties and improved strains have been introduced after a thorough test. The Alipur strains of Cosmos, annual *Hibiscus* and *Tithonia* are the results of cross-breeding work.

In 1935 His late Majesty King George V graciously granted the Society the privilege of using the title 'the Royal' in recognition of the long and useful service which the Society has rendered to India.

DAIRYING AND RURAL IMPROVEMENT

By Roshan Lal Tandon, B.Sc. (Hons.), M.Sc. (Tech.)

Food Chemist, Field Research Station, P. O. Ichhra, Lahore

NO enterprise in dairying can survive the cut-throat competition of the city *gowallas* (milkmen) as the public at large has not developed a sense of appreciating cleanliness. People are always attracted by cheap rates and the quality of milk that they get is perhaps good enough for the price they pay for it. Dairying in the real sense is in its infancy in India and the Government must foster it if any advance in this direction is desired. The present state of affairs is utterly hopeless.

The Hindu zemindar, who reveres the cow as the mother of prosperity and who has this reverence ingrained in him by religion, is by force of circumstance led to treat cows and bullocks in the most inhuman way. He will practise all sorts of cruelties on them only short of slaughtering them. This is because his economic condition does not allow him to feed his cow properly and his religious dogmas do not allow him to slaughter her. This results in accumulation of half-starved animals which neither give milk nor work the plough, and what is sufficient to maintain only one animal is thus fed to four animals. Thus the struggle for existence goes on.

Cruelty to animals

Production and sale of milk in big cities in the Punjab is generally in the hands of uneducated *gowallas*. They house their cattle in big cities where fodder is very dear and the cost of upkeep high. They must of necessity keep the best animals and in order to make both ends meet they either half-starve the animals or adulterate the milk. Usually both methods are practised to get the highest return. These people have little foresight, and therefore do not realize that by starving the animals they will be the ultimate losers. They resort to all sorts of inhuman practices like *phuka* to get more milk, and they have not the slightest scruple because they know that ultimately they can sell the animal to the butcher. In big dairies maintaining large herds of cattle, for some reason or the other only this class finds employment as milkmen, and by force of habit and tradition these *gowallas* as a class feel no compunction in practising their cruelties on animals.

As a result of the activities of the Education Department, school education has been brought within easy reach of villagers and here and there one does come across matriculates in villages. These boys are a burden to their parents since they neither find employment nor are they of any help to them on the land. The parents are therefore becoming averse to sending their children to school. If these boys could be offered petty jobs as milkmen, deliverymen, milk writers, etc. in any dairy organization, it will afford great relief to the poor agriculturists. This class of dairy worker is likely to be more intelligent, more efficient and more humane in treating the animals under his care.

Rapid turnover

This is, however, one aspect of the question. In the Punjab, the chief item of expense in feeding a dry cow or buffalo is fodder. The dry period of a good country cow is seldom less than six months and the cost of feed, etc. of this animal cannot be less than Rs. 8 per month, which means at least Rs. 48 till next calving. A number of animals, especially the high yielders, do not get served till late in their lactation period and the cost of maintaining them during the entire dry period is prohibitive, for a new animal can be purchased at lower cost and the old animals can be sold off for Rs. 25 to 30 to some unknown person probably the butcher.

There is another class of animals which do not get served at all on account of mishandling

Ved & Co.

His Excellency the Viceroy making friends with the champion Mudini at the All-India Cattle Show,

[PLATE

Sir Girja Shankar Bajpai, member for Education, Health and Lands, demonstrating a point to their Excellencie

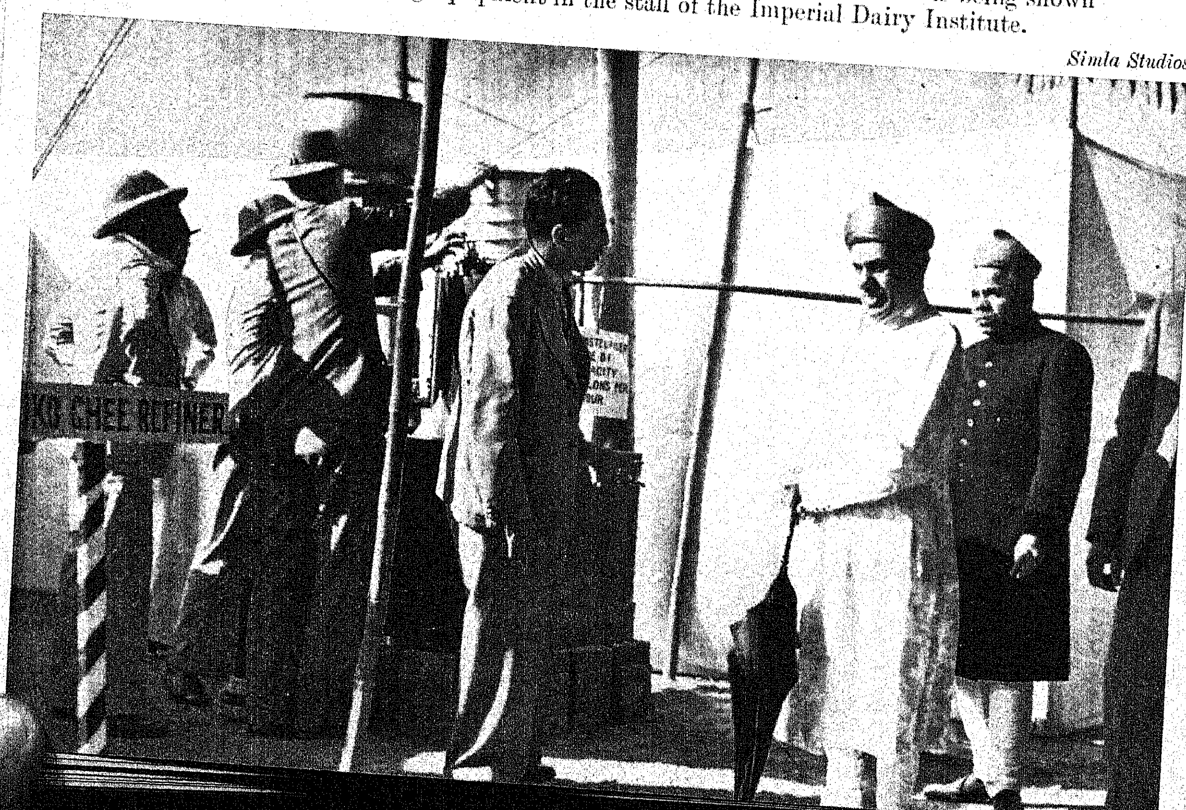
Ved & Co.

His Excellency the Viceroy has a chat with H. H. the Maharaja of Dhrangadhra *Simla Studios*

[PLATE 55

Another distinguished visitor to the Show was the Raja of Bhor. He is being shown the ghee-refining equipment in the stall of the Imperial Dairy Institute.

Simla Studios



or poor feeding, and this number is on the increase; sometimes they happen to be the best animals but have to be sold off without giving them the chance to show their best. Private owners sometimes send their dry cows to zemindars in rural areas for the sake of cheap maintenance. Almost invariably such animals are kept half-starved and are never looked after. This starvation is reflected in the next lactation of the naimal in the form of poor yield, under-weight calves and poor condition of the animal. The calves do not get enough milk, remain stunted and so the cycle goes on.

The discouraging or total prohibition of the housing of cattle in cities by *gowallas* who produce milk under the most insanitary conditions and adulterate it by all ways and means, and the organization of supplies of milk from rural åreas will be a very useful step in stopping the depletion of the valuable livestock wealth of the country and the consequent deterioration in quality.

Milk more profitable than ghee

When the zemindars realize that their animals are a source of income and afford them ready money to purchase feed in times of scarcity, they will treat them better, especially the young stock which is to be the foundation of our milch and work cattle. Under present circumstances the zemindars usually convert their milk into ghee and sell it. This is a source of income to them, but it has to be realized that while 20 lb. of milk will fetch only 10 annas in the form of ghee, it will fetch 15 annas if sold as milk at the rate of 1 anna 6 pies per seer, and this without having to undergo the extra trouble of boiling, souring, churning and making ghee with the consequent losses. The cash return that zemindars get from converting milk into ghee is too meagre if the cost of labour is taken into account.

In towns green fodder and *bhusa* sell at 4 annas and 12 annas per maund respectively. A good country cow yielding about two gallons of milk requires about a maund of green fodder alone, or say 40 lb. green fodder and 7 lb. *bhusa*. Thus the cost of fodder alone amounts to 3 or 4 annas.

This animal will require in addition about 8 lb. of concentrates, the cost of which will on average amount to 2½ annas. Thus in towns one has to spend more on fodder than grain while the reverse is true for village conditions.

Policy advocated

Private owners, however, if they are to be stopped from keeping milch cattle, should have a guarantee that they will be able to get pure and unadulterated milk for household consumption. To ensure this all milk coming from the rural areas should be received in a central dairy or depot and sold at reasonable rates after proper treatment. Secondly, the persons who supply milk to these dairies in each district should be granted permits and these should be liable to be cancelled for any reports made against them. Thirdly, the Government or the municipality should be empowered to fix local rates for the purchase and sale of milk by the central dairies so that both the owners of dairies and the producers of milk can make reasonable profits only. Fourthly, in very big cities more than one dairy or depot should be installed to supply the demand of customers. Fifthly, these dairies, to begin with, should not be placed under the administration of municipalities or boards, otherwise corruption is likely to become rampant and defaulters may not be punished under the cloak of communal protection. They should preferably be run by private owners under Government patronage. Lastly, the health officers of the Government and senior medical officers should pay surprise visits to these dairies.

The Agricultural Assistants and Veterinary Inspectors located in each district can be asked to report on the condition of cattle in their district and owners who wilfully neglect proper feeding should be reported and their licences should be cancelled. Healthy rivalry should be promoted amongst cattle owners by awarding prizes for the best-maintained cattle. Villagers should be encouraged to form co-operative unions for the production and sale of milk in bulk.

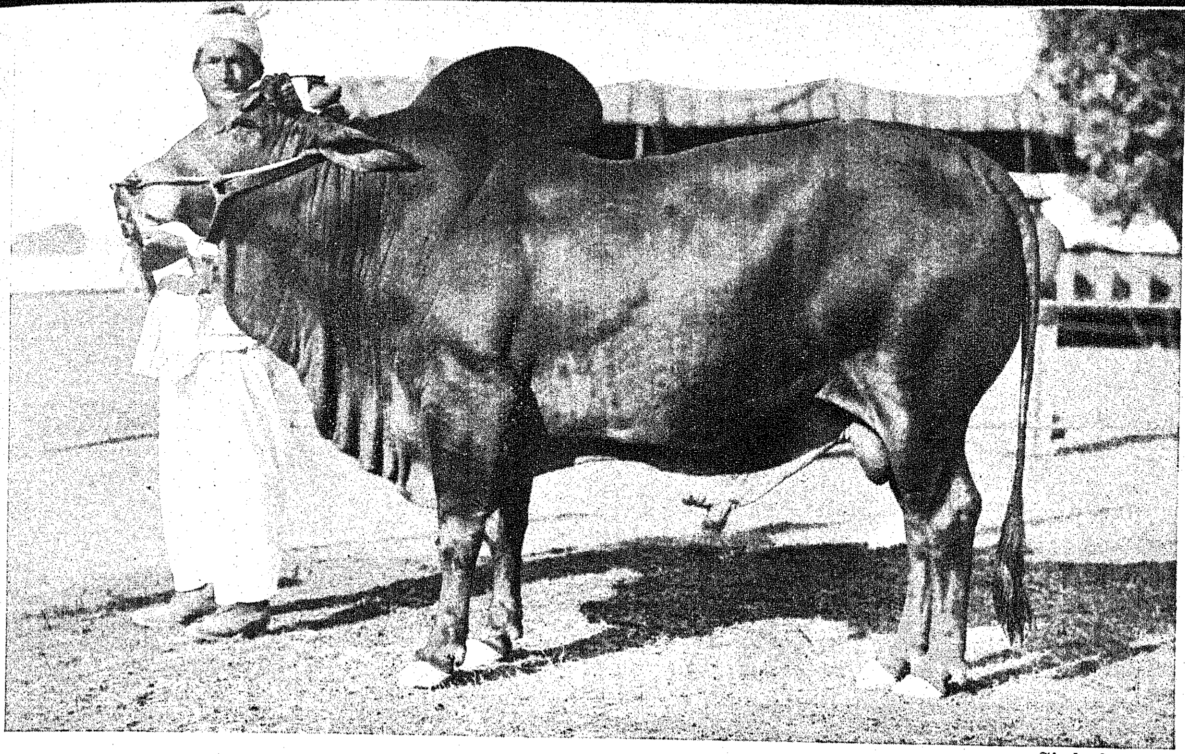
Government initiative

The public is too lethargic to take the initiative in such matters. There must be propaganda; there must be legislation; and

there must be keen watch and ward by the Government. Milk supplied to towns must be produced in rural areas only to afford means to zemindars to earn cash as this is an important aspect of rural uplift.

In towns like Rangoon, Penang, Singapore and in smaller towns in the Federated Malay States no one is allowed to keep cattle within certain limits of towns and the cattle kept outside for supplying milk are inspected by the sanitary boards.

The scheme outlined above will have manifold advantages. It will promote cleanliness in towns; it will ensure safe supply of milk; it will allow animals being kept in rural areas; it will promote sound dairying, and it will help the zemindars in each district by affording them means to increase their income, and this will lead to rural improvement which is the aim of everybody in the country. The situation calls for economic statesmanship.



Simla Studios

The best bull in the Show

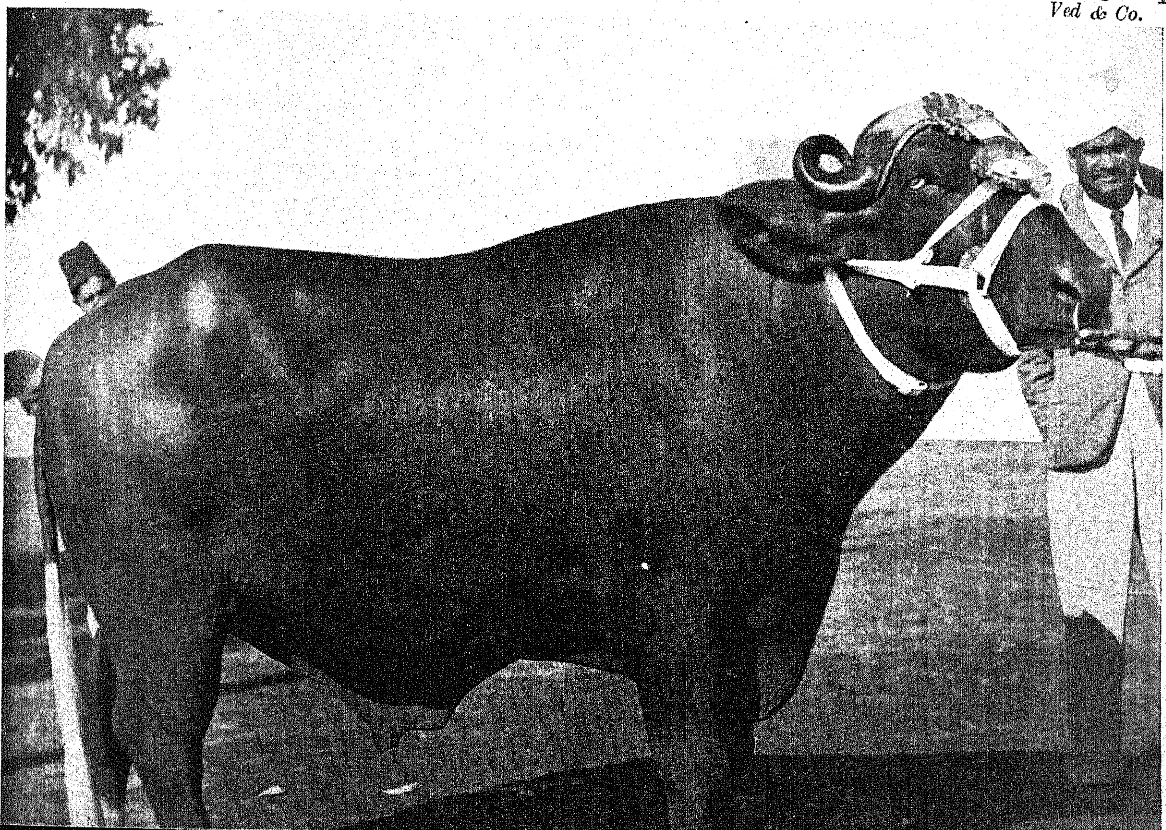
This bull, a beautiful specimen of the Sindhi breed, was exhibited by the Livestock Officer, Sind

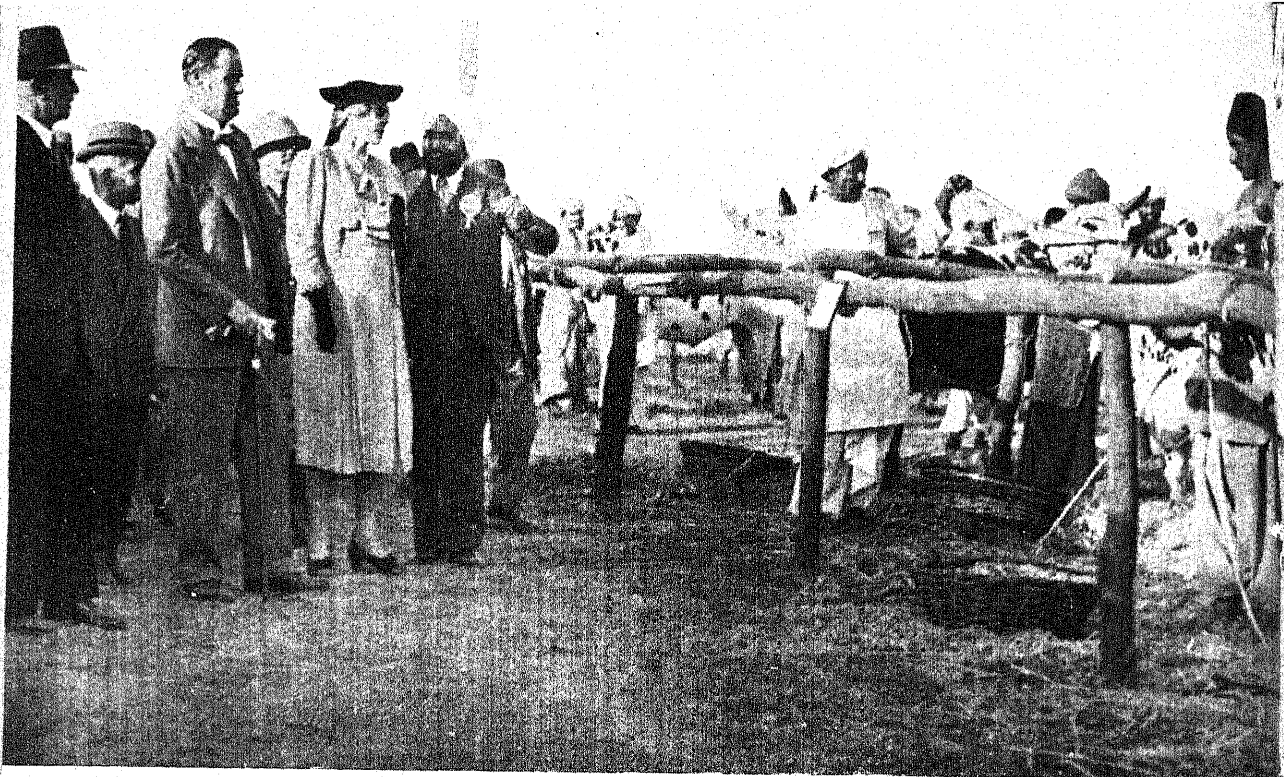
The best buffalo bull in the Show

[PLATE 56

Baisakhi Prince, belonging to the Military Dairy Farm, Ferozepore, won the Saidullah Khan Challenge Cup

Ved & Co.





Ved &

Sir Datar Singh explaining the points of a good animal to Her Excellency, Lady Linlithgow

[PLATE 5

Their Excellencies discussing the points of a Dhanni bull at the Show

Photo Servi

What the Scientists are doing

INDIAN SCIENCE CONGRESS

RECENT advances in agricultural science were discussed at the Indian Science Congress, which met at Benares in January. The President of the Agricultural Section, Mr K. Ramiah, of the Institute of Plant Industry, Indore, discussed the question of plant breeding and genetical work in India.

He began with a survey of the practical results of plant breeding, the spread of improved types evolved by plant breeders and how they have contributed to an increase in the output of the country. He explained why it would not be fair to compare the standard yields of crops in India with similar crops in other countries registering high yields, and drew attention to the urgent necessity for improving agricultural statistics. From his knowledge of plant breeding work carried on in more advanced countries, he considered that the standard of such work in India would compare very favourably with that of any country in the East or West.

Better use of research

From actual examples of plant breeding efforts in progress in India in rice and cotton, he pointed out how the recent advances in genetics could be better utilized to produce more tangible results. He considered that it was only the study of quantitative inheritance that could influence plant breeding methods and drew attention to the importance of such studies going on in Indore on cotton. The importance of crosses with wild types in certain problems of plant breeding was stressed and in this connection it was stated that India could provide new wild and related forms to some of our important crops if only a systematic exploration was undertaken.

Central bureau suggested

Mr Ramiah considered that while crop botanists employed in the several Agricultural Departments have to go on with the more pressing problem of evolving improved types of crops the growing of which would bring in a greater return to the cultivator, the carrying on of basic research on crops on an all-India basis was also very important. In this connection he suggested the setting up of a central organization under the auspices of the Imperial Council of Agricultural Research on the model of the Bureau of Plant Industry in the United States of America. In his view, the problems that could be entrusted to such an organization were : (1) coordinating crop research going on in provinces and states, (2) undertaking basic research of an all-India character on the more important crops, (3) taking charge of the introduction and testing of new crops from outside, and (4) arranging for special expeditions to explore key regions of crops in India and outside.

Finally, he made a strong plea for a larger share of genetics in the syllabuses of honours courses in biology in the universities and for greater cooperation between crop botanists in Agricultural Departments and the post-graduate departments of botany in the universities. Two lines in which such cooperation could prove beneficial were cytological research in agricultural crops and the collection and taxonomical study of wild and related forms of the chief crops of the country.

Reading of papers

There were over 70 papers contributed to the section, grouped under various subjects such as agricultural meteorology, soils and agricultural chemistry, study of crops and crop products, plant breeding and genetics, crop physiology, plant diseases, statistics and sampling technique and agricultural economics. Of the above, about 40 were actually read and discussed at the sessions, the rest having to be taken as read, as the authors of these papers were not actually present in Benares. The papers on soils and agricultural chemistry were discussed at a joint meeting with the

Indian Society for Soil Science, and of the several papers in this group, special mention might be made of those relating to results obtained in reclaiming eroded and alkaline soils. The papers on statistics were similarly discussed at a joint meeting with the Indian Statistical Society.

Joint discussions

The most important events of the session were the joint discussions on topics of general interest. The three topics that had been selected for discussion at this meeting were: (1) drought resistance in plants, (2) the need for the exploration of wild forms in the improvement of crops, and (3) quality in crops.

Two other subjects discussed at the Benares session in which the Agricultural Section cooperated with other sections, were 'Nitrogen fixation in the soil' and 'Food Plânning'.

***

GUINEA GRASS AS FODDER

GUINEA grass is a well-known perennial fodder which is also found to do very well under the shade of trees, such as mango where no other crop would thrive. Dr Mann in Bulletin No. 100 of the Bombay Agricultural Department, *Fodder Crops of Western India*, says that maximum annual yield per acre was obtained at Karachi under raw sewage. In these conditions eight cuttings per annum per acre of 25,000 lb. or an annual total of 200,000 lb. green fodder was obtained.

Attempts were made at the Agricultural College Dairy, Kirkee, to find out the maximum limit up to which the crop would yield under heavy manuring. With a view, therefore, to achieving this, a plot of 21 *gunthas* (21/40 acre) was planted in June and July 1933 after good preparatory tillage and manuring with 17 carts of fresh dung and 8 carts of farmyard manure before and after ploughing respectively. Thereafter the plot was manured from the byre washings of about 70 to 80 animals.

The yields of this crop in the first year in various cuttings is enumerated below:

No. of cuttings	Time	Yield per acre
		lb.
1	August	2,826
2	September	13,120
3	November	4,160
4	December and January	4,266
5	March	10,766
	TOTAL	35,138

In the second and third years it yielded 92,921 and 151,605 lb. per acre in six and nine cuttings respectively. During these years, the crop received only washings from the byres of some 70 to 80 animals. A similar attempt to get the maximum yield from the crop has been made this year (1940-41). A plot measuring 33 *gunthas* was planted with the crop in April and June without any previous manuring and the byre washings of about 70 to 80 animals spread on the plot. The yields obtained in various cuttings are as under:

No. of cuttings	Time	Yield per acre
		lb.
1	July	1,223
2	September	46,969
3	November	10,523

Two more cuttings are likely to be available from this plot by the end of March 1940, when it is expected that it will break the record for a first-year yield of the crop in Western India. The crop appears to be yielding least during the cold weather. All the same, this grass may be taken as a good perennial fodder crop suitable for supplying green material to the stock all through the year.

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PYRILLA IN THE DECCAN

THE first serious report of this insect pest was received in July 1939 from the Deccan Canals area. This year it

assumed a serious aspect in the Canals area. It was present to the extent of 100 adults per leaf on an average and was found breeding on *jowar* crop as well. At the Poona Agricultural College Farm the insect was found to have increased to a considerable extent in 1940. The pest is found to be active from July onwards.

The following measures were tried on the College Farm and have given promising results:

(1) Stripping off the leaves from the lower surface, especially those which bear the egg-masses, and burning them.

(2) Spraying kerosene oil emulsion: 1 oz. of kerosene—1 oz. of bar soap in one gallon of water.

***

I. A. R. I. DIPLOMA

MR P. L. Chaturvedi has been awarded the Diploma of the Institute (Assoc. I.A.R.I.) after the completion of the two-year postgraduate course in entomology commencing from November, 1938, and the acceptance, by the Institute Council, of his thesis entitled 'Biology of *Melanagromyza Phaseoli*, Coq.'

F

What would you like to know?

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section will be reserved for replies to selected letters in cases where it seems that the information might be of general interest.

INFORMATION PLEASE

Q: Can any reader tell us where seed of the fodder plant *Kudzu* (*Pueraria thunbergiana*) can be had in India? (See INDIAN FARMING, Vol. II, No. 1, p. 36)

A: The *Kudzu* vine was planted at the Government Cattle-breeding Farm, Himayatsagar, Hyderabad-Deccan, four or five years ago, when that farm was under the Department of Agriculture. (It is now under the Veterinary Department.)

I had obtained cuttings of the vine from the Imperial Agricultural Research Institute, Pusa. I had learnt about it from an article entitled 'Kudzu vine (*Pueraria thunbergiana*)' by N. V. Joshi (*Agriculture and Livestock in India*, Vol. 3, 1933, Pp. 586-92).

The creeper still exists at the Himayatsagar Cattle-breeding Farm. It is grown well and is being used for feeding cattle.—NIZAMUDDIN HYDER, Director of Agriculture, H. E. H. the Nizam's Government, Hyderabad-Deccan.

Q: I learn from recent issues of INDIAN FARMING that

(1) Alumina and iron retard plant growth (March, 1940, p. 125) and

(2) The bases (in this case calcium) in hot climates tend to remain, rendering the soils generally alkaline (July, 1940, p. 350).

These statements and the chemical analysis of the soil proved to be true and markedly visible when Virginia flue-curing tobacco is grown. Though the land is sufficiently sloping, the base, calcium, is not washed off amply to reduce the alkalinity.

In view of the chemical and mechanical analysis of the soil furnished hereunder, I would like to know what organic and inorganic manures to constitute a complete fertilizer will suit the soil to minimize the evil effects of alumina, iron and calcium to grow good flue-curing tobacco and generally the alkalinity of the soil?

Chemical analysis

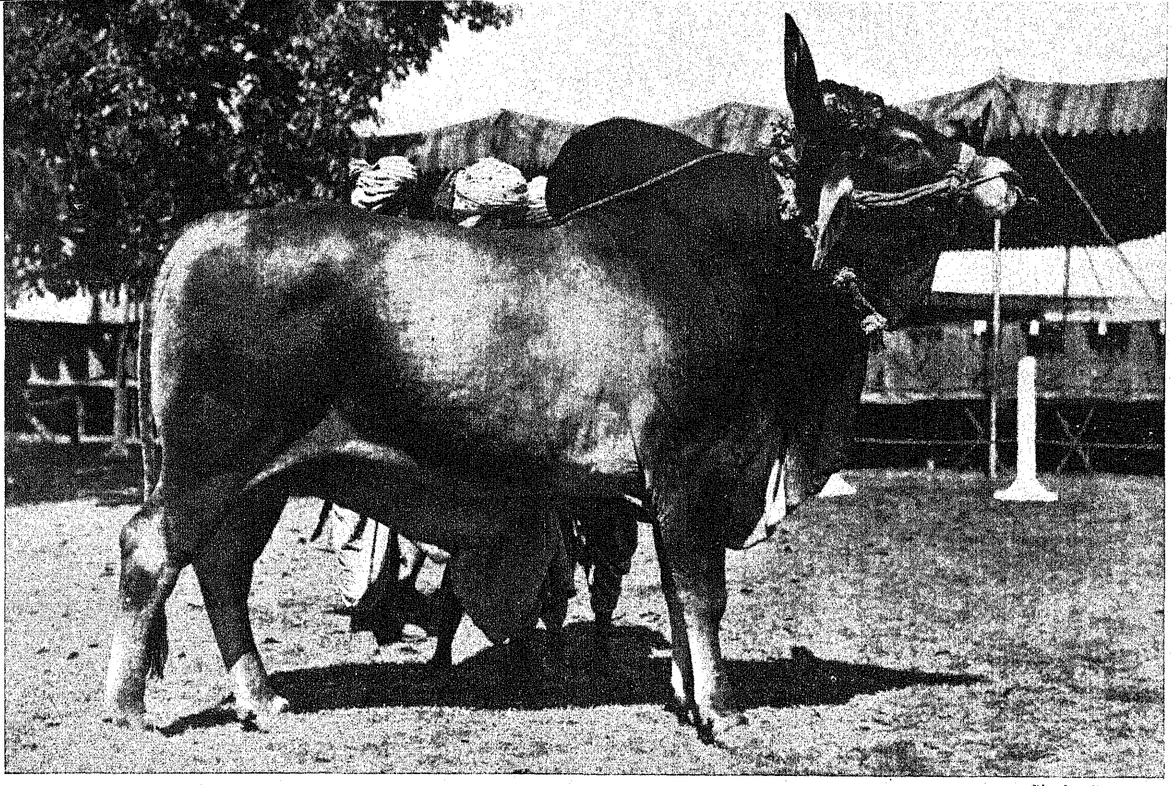
	Per cent
Moisture	8·34
Organic matter	5·65
Insoluble minerals	71·11
Iron (Fe_2O_3)	5·75
Alumina (Al_2O_3)	10·61
Lime (CaO)	3·66
Magnesia (MgO)	1·02
Potash (K_2O)	0·78
Soda (Na_2O)	Nil
Carbon dioxide (CO_2)	1·62
Phosphoric acid (P_2O_5)	0·038
TOTAL	100·238

Calculated salts—

Calcium bicarbonate	0·0283
Sodium bicarbonate	0·0001
Sodium carbonate	0·0005
Sodium sulphate	0·0091
Sodium chloride	0·0057
Total solids	0·037
pH	8·73

Mechanical—

Clay	56·18
Silt	16·36
Fine sand	18·95
Coarse sand	6·01
Acid solubles	2·50
TOTAL	100·00

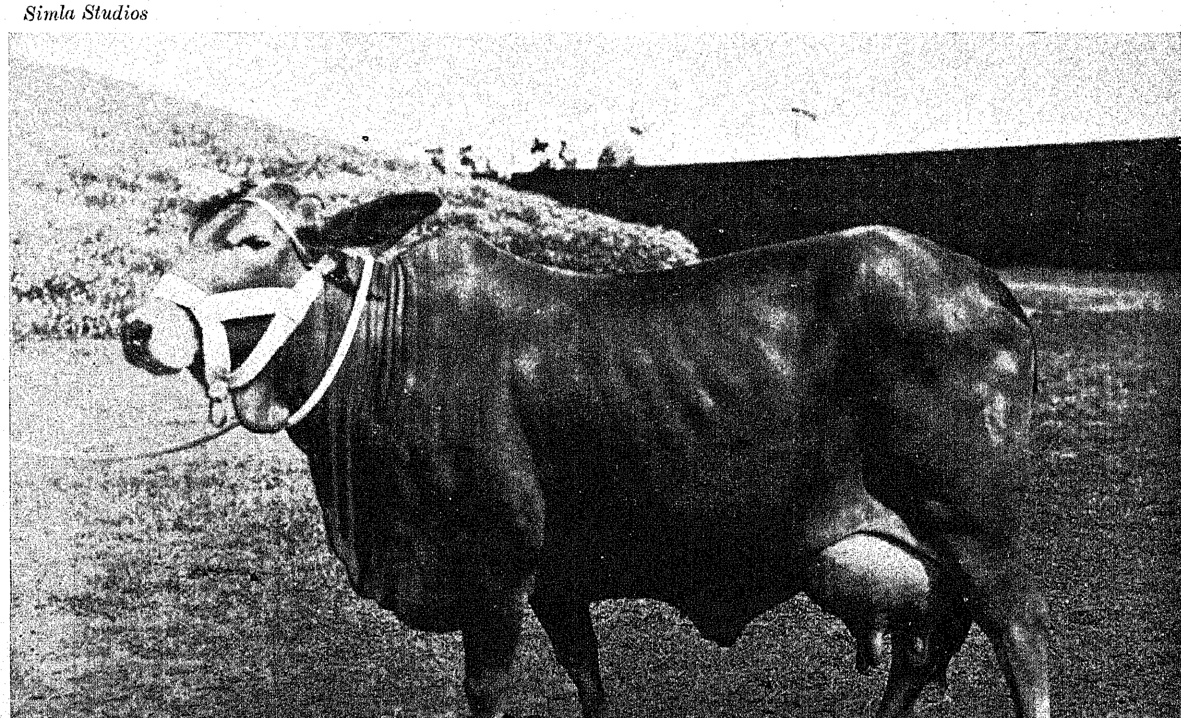


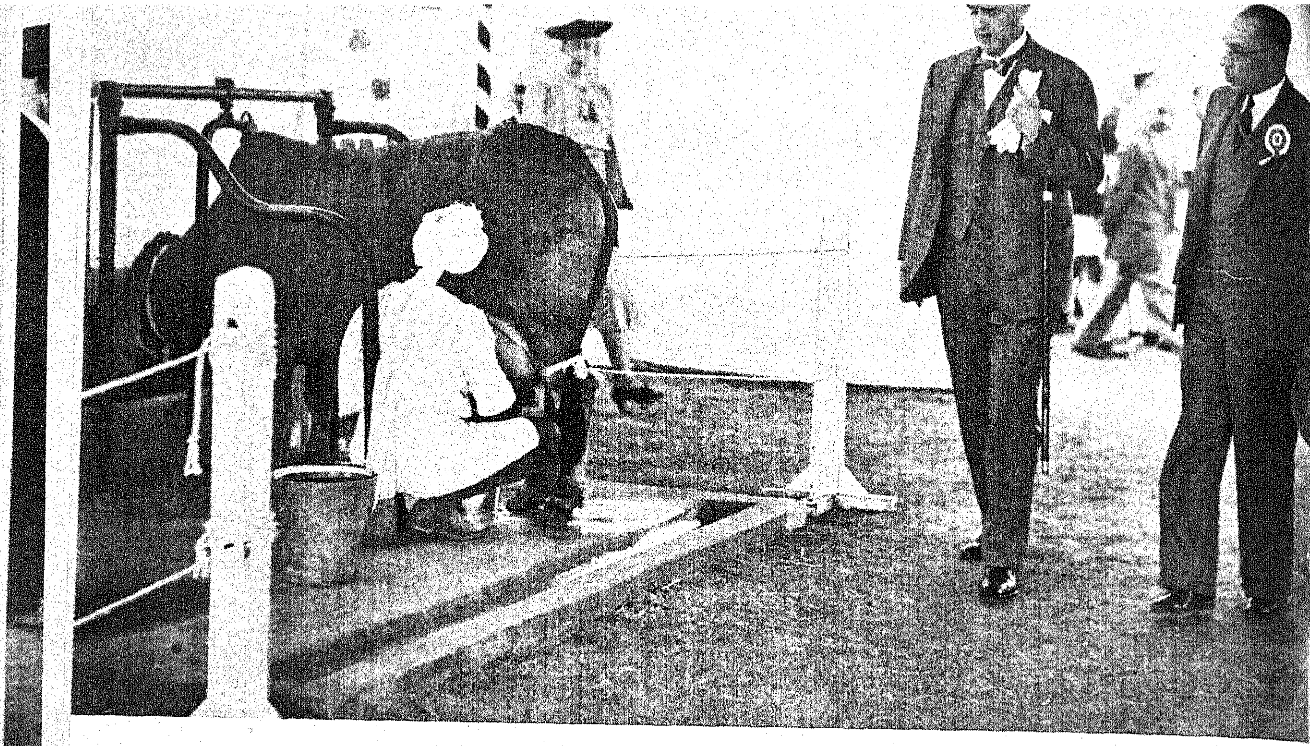
Simla Studios

A young Kankrej bull which won a prize at the Show

A young Sahiwal prize-winner

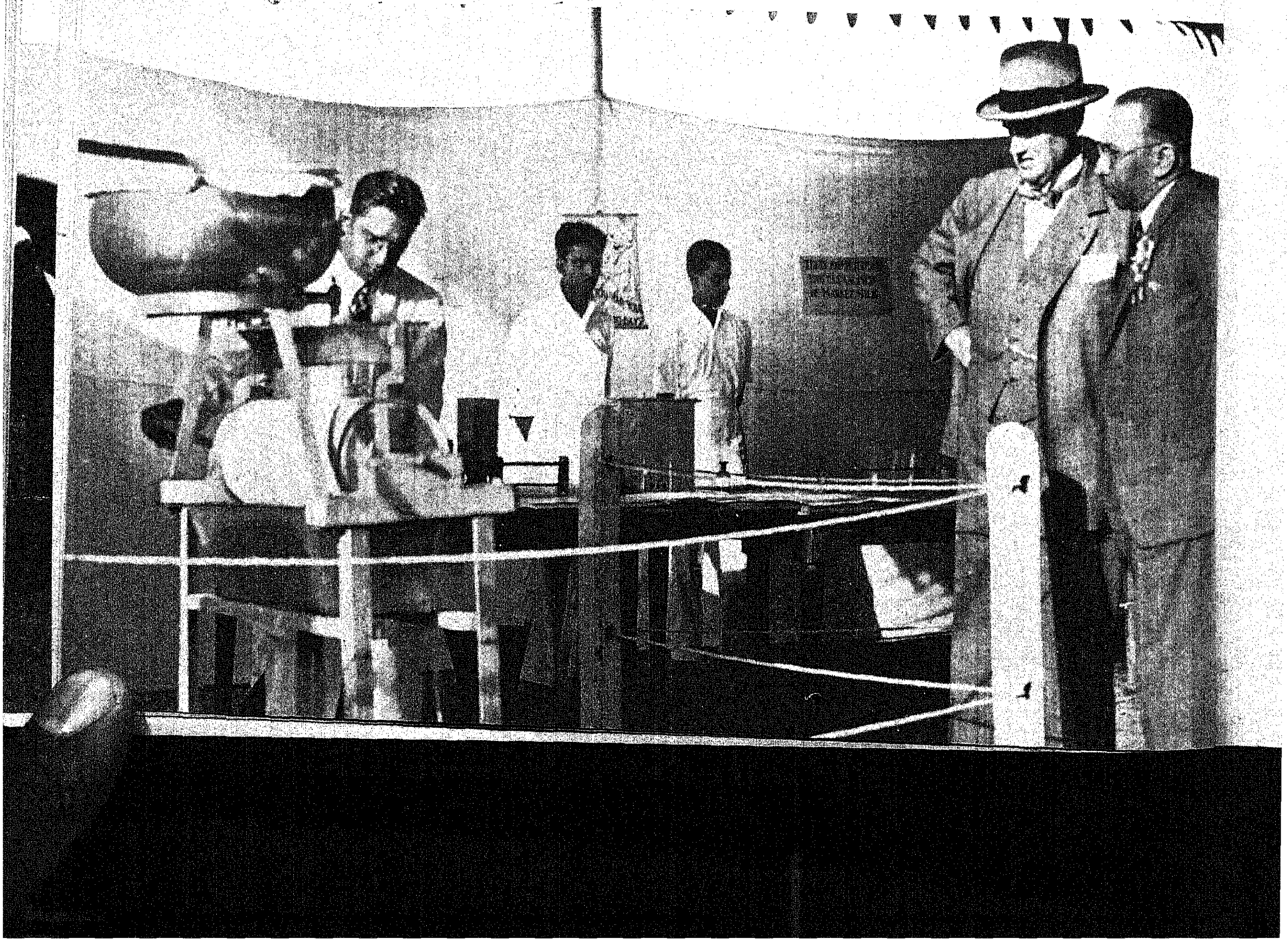
Simla Studios





Their Excellencies watching the milking of a Sahiwal cow. Mudini won the milking competition again this year, with 51 lb., beating her own previous record.

His Excellency the Viceroy interested in the processing of milk demonstrated at the Show by the Imperial Dairy Institute, Bangalore



A : The observations in the two articles in INDIAN FARMING of March and July of 1940 do not apply to the soil mentioned by the correspondent. The amounts of aluminium, iron and calcium found in the soil mentioned in the query are not present in excessive or extraordinary proportions to act adversely on plant-growth. Such quantities are normally present in most arable soils maintaining good crop-growth, and as such are not likely to be harmful to the growth of tobacco as apprehended in the query. The soil, however, seems to be rather low in phosphate and potash. A dose of phosphatic, potassic and nitrogenous manures in both organic and inorganic forms will, therefore, be beneficial. Farmyard manure, leaf mould or green manure may serve as nitrogenous, sulphate or muriate of potash as potassic, and superphosphate, finely crushed bonemeal or artificials like ammophos or niciphos as phosphatic manures. Their relative proportions should be such as to maintain a ratio of 15 lb. nitrogen : 75 lb. phosphate (P_2O_5) : 50 lb. potash (K_2O).

A fertilizer mixture of the above composition has been found to be suited for manuring flue-cured tobacco. Further information on the subject will be available in short Press Notes Dominion Department of Agriculture, Canada, on pp. 461 and 625 of September and December (1940) issues respectively of INDIAN FARMING.

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Q : Owing to the failure of seasonal rains transplantation of Virginia flue-curing tobacco is delayed and consequently the harvest. The middle portion of the harvest falls at a period when the atmospheric temperature rises and relative humidity falls which impairs the quality of the cured leaf. I would like to know whether vernalization of tobacco seeds before sowing in beds will help in hastening the harvest of the leaf by at least a fortnight ? If so, with what precautions ?

A : From experiments that are being conducted at the Imperial Agricultural Research Institute, the indications are that vernalization of tobacco seeds before sowing does not hasten the harvest of the leaf. Work on this crop is still in the preliminary stages and, until the results are found to be definitely encouraging, the method of vernalization cannot be recommended to the agriculturist.

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Q : Is it possible to make dry *lassi* which can be sent for the use of soldiers serving abroad ?

A : The drying of *lassi* as a food for Indian troops is an interesting suggestion. The difficulty rests in preserving the capacity of the product to form a complete solution when reconstituted with water. It is feared that the sour product after drying would not provide a powder which would go into complete solution and that the difficulties attending the drying of slightly sour skim milk would occur. The *lassi* would have to be pasteurized before drying which would cause curdling and a cheesy product would be given in both condensing and drying operations. It would perhaps be better to dry a sweet *lassi* containing some flavouring materials of a buttermilk nature, but even these flavours would partly evaporate in the drying process.

CATTLE ON SHOW

By F. M. de Mello, B.A., B.Sc. (Econ.)
Editor, Imperial Council of Agricultural Research

DELHI used to have a 'week' in February during which the Horse Show, the chief attraction of the season, attracted visitors from all India. In wartime, the Horse Show has been abandoned, together with other social events. Nevertheless, the All-India Cattle Show, first organized in 1938, persists. The fourth Show, held from the 17th to the 22nd February, was bigger and better than ever. The exhibits reached a record of 820 animals, which compares very favourably with last year's total of 706. In 1938 the number was 488: the increase is significant of the popularity which the Show has gained. Nearly all the recognized breeds of cattle and buffaloes were represented: some of the largest entries were Sahiwal (87), Hariana (85), Hissar-Hansi (64), Nimari (37), Red Sindhi (34), among cattle; and Nili (74), Ravi (52) and Murrah (40), among buffaloes. For the first time Kherigarh and Ponwar cattle from the United Provinces and Kundi buffaloes from Karachi were brought to the Show in Delhi.

Former prize-winners beaten

Competition was very keen, and the judges had in many cases great difficulty in awarding the prizes. From year to year the standards have gone up, and this year newcomers to the Show beat former prize-winners and carried away the cups. Halim, a buffalo cow owned by a Rohtak ryot, won the cup for Murrah buffaloes, beating the two former winners of the Viceroy's Cup for the best animal in the Show, now owned by His Highness the Maharaja of Bharatpur.

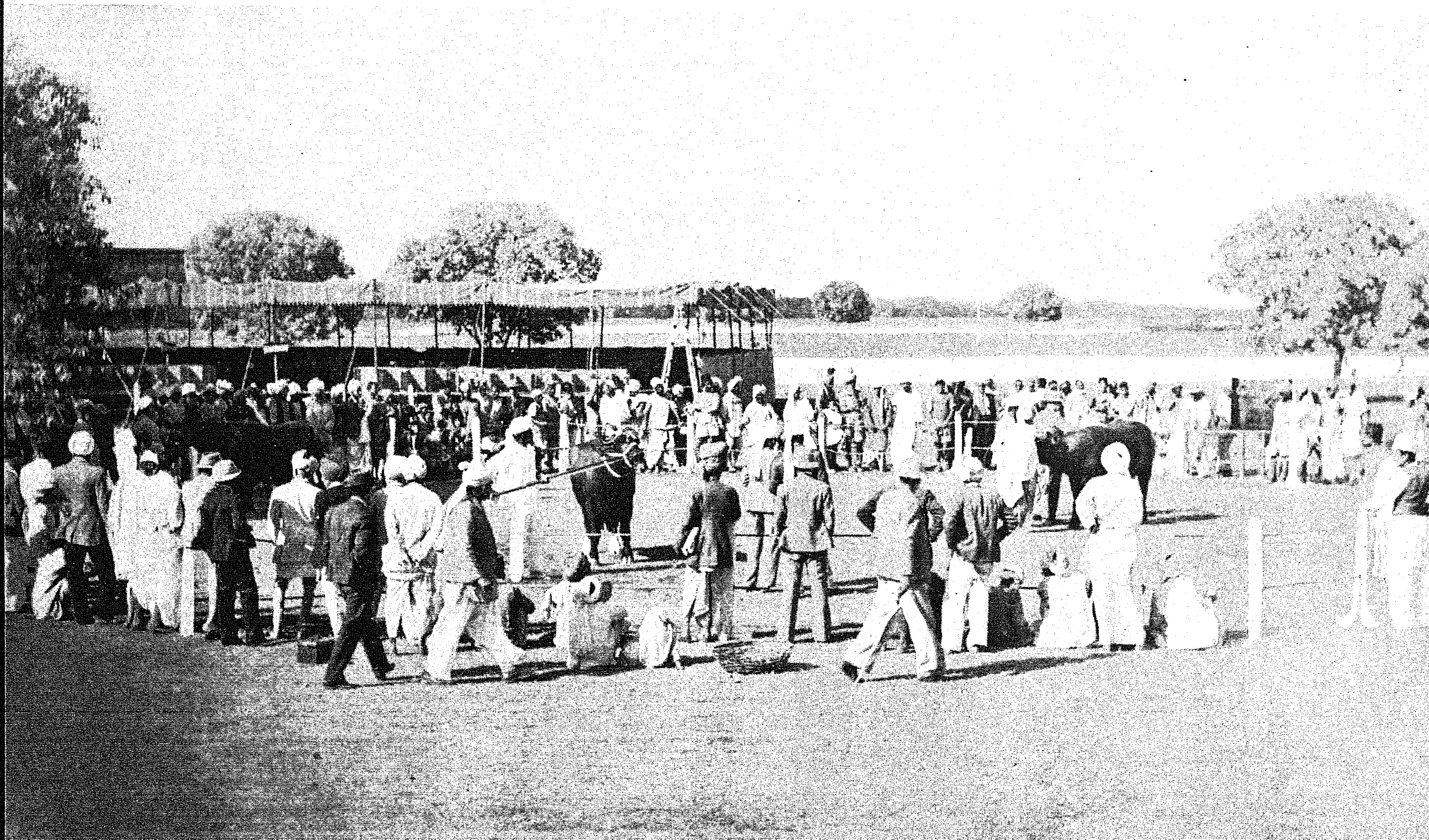
Better fortune, however, awaited Mudini, the Sahiwal cow owned by the Ferozepore Military Dairy Farm. She won the cup for the best cow in the 1940 Show. She won again this year the cup in the milking competition with an average of 51 lb., beating her previous record, and she was adjudged the best animal in the Show. With her numerous rosettes she looked quite gay on the day of the prize distribution, being paraded six times when the Manager of the Ferozepore Military Dairy Farm was called to receive the prizes. It is extremely gratifying to note a prize-winner of this breed holding her own against all comers. Another outstanding animal was a fine Red Sindhi bull from the Willingdon Cattle Farm, Malir. The judges' remark on this animal was that it was a beautiful specimen, and so it was, with its magnificent proportions and rich colouring.

An innovation of this year was the students' judging competition which attracted nine competing teams. The two teams from Lyallpur were first and second and the third came from the Izatnagar Institute. There were two new classes this year, one for the best general utility cow won by the Superintendent, Government Cattle Farm, Hissar, and another for the best general utility bull won by the Manager, Northcote Cattle Farm, Chharodi. The cups were given by Lala Shankar Lall, Millowner, Delhi, and His Highness the Maharaja of Bharatpur, respectively.

Two rubber-tyred carts were offered by the Indian Roads Congress for pairs of bullocks. The first prize was won by Phoolo of Parwar, Rohtak district, and the second by His Highness the Maharaja of Bharatpur.

Demand for prize cattle

It is understood that a fair number of animals brought to the Show were sold. There were keen buyers who had come to the Show specially to make purchases of prize cattle. Among them was a representative of the



Ved & Co.

A general view of the judging ring at the All-India Cattle Show

[PLATE 60

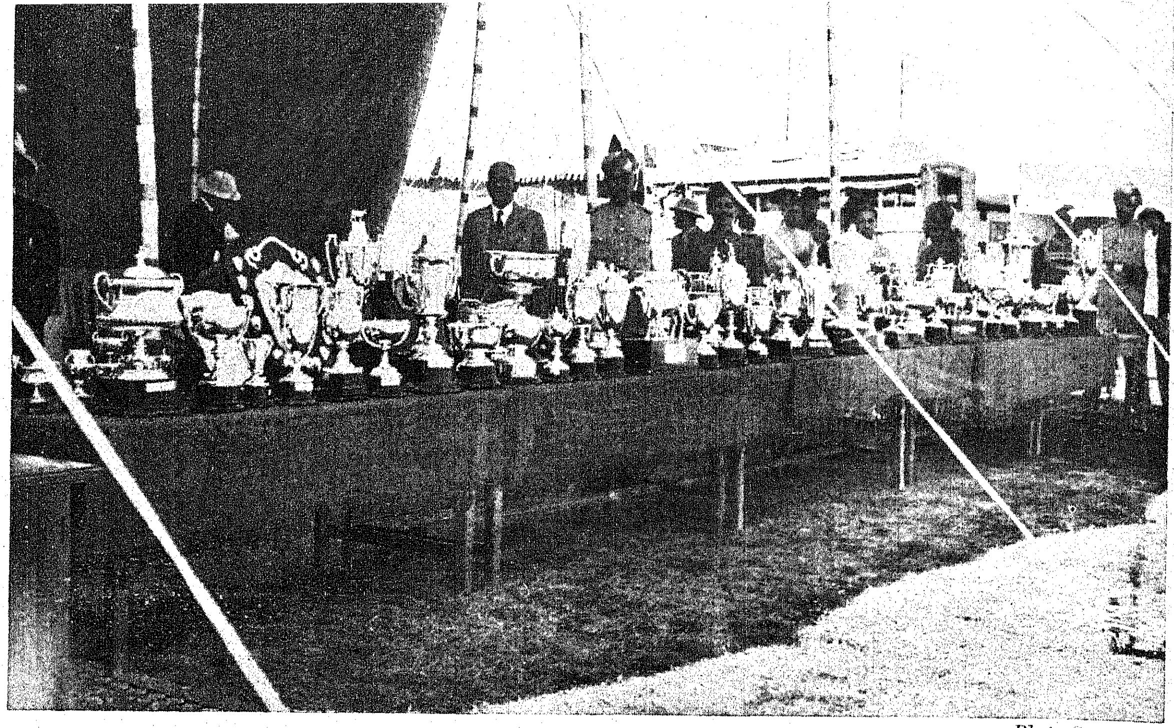


Photo Service Co.

Cattle Show cups

[PLATE 61

Sir Girja Shankar Bajpai giving a prize to Khan Sahib Ulvi, who exhibited the best bull in the Show, a Red Sindhi

Photo Service Co.

Ceylon Cattle Breeders' Association, who was specially interested in Red Sindhi and Sahiwal cattle. Another buyer was from Bundelkhand State, interested in the Hariana and Tharparkar breeds.

His Excellency the Viceroy with the Marchioness of Linlithgow visited the Cattle Show on the afternoon of the 20th. They showed keen interest in the animals and in the demonstration stalls set up by various departments. On another afternoon Mr A. V. Askwith, Chief Commissioner of Delhi, brought a group of farmers who spent many happy hours among the cattle and listened avidly to the talks arranged for them on animal breeding problems.

The stall of the Animal Husbandry Bureau where publications of the I C A R were displayed attracted some attention, especially a series of pictures from Brazil of Ongole cattle born and reared in that country. Even more popular was the stall of the Imperial Institute of Dairying at Bangalore where demonstrations were given, among other things, of cheese-making and the processing of milk. Another interesting stall was that of the Agricultural Marketing Adviser where methods of grading eggs, butter and ghee were shown.

An educational experience

The prize money distributed amounted to Rs. 11,235, of which Rs. 3,600 was given with cups. Government exhibits took no cash prizes.

The prizes were distributed by Sir Girja Shankar Bajpai, Member for Education, Health and Lands in the Government of India. Speaking in English and Hindustani, he congratulated the prize-winners who had brought their animals long distances in some cases. The Show, he said, was a great educational experience.

For the first time this year a Poultry Show was held in conjunction with the Cattle Show. Well-known breeds of poultry such as Rhode Island Reds, White Leghorns and Black Minorcas were represented. There were a good many exhibits of Indian breeds, particularly the Aseel from Rampur, the Chittagong and the Naked Neck breed from Bombay. Unfortunately, two cases of Ranikhet disease were detected on the second day of the Show and the exhibitors were asked to take their birds away. The prizes were distributed on the third day, as previously arranged, by Lady Lloyd.

PRIZE-WINNERS AT THE ALL-INDIA CATTLE SHOW, 1941

SINGLE BREED CUPS

Donor	Cup and Event	Winner	Cash Rs.
*H. H. The Raja of Faridkot .	The Faridkot Challenge Cup for the best Dhanni bull	Karam Ali of Khewal (Jhelum)	100
†Sir Muhammad Nawaz, Kot Fateh Khan	The Kot Fateh Khan Challenge Cup for the best Dhanni cow	Ghulam Mohd. of Chattal (Jhelum)	50
The Thakur Sahib of Palitana .	The Palitana Challenge Cup for the best Gir bull	Kumar Shri Nirmalkumar Sinhji, Bhavnagar State	100
The Thakur Sahib of Sayla .	The Sayla Challenge Cup for the best Gir cow	Nathu Lalji Charity Trust Cattle Breeding and Dairy Farm, Mulund	50
H. H. The Maharaja Sahib of Morvi	The Morvi Challenge Cup for the best Gir heifer	Kumar Shri Nirmalkumar Sinhji, Bhavnagar State	50
The District Board, Rohtak, Punjab	The Sir Chhotu Ram Challenge Cup for the best Hariana bull	Sheo Dan, Dakhla (Rohtak) .	100
The Raja Durga Singh Ji of Baghat	The Baghat Challenge Cup for the best Hariana cow	Neki, Madina (Rohtak) . .	50
†The District Board, Rohtak, Punjab	The Dalpat Singh Challenge Cup for the best Hariana heifer	Ch. Thana, Pehladpore . .	50
†The District Board, Rohtak, Punjab	The Sir Henry Craik Challenge Cup for the best Hariana young bull	Chiman, Baroda . . .	50

* Cups provided with miniatures.
† Cups received after the 1940 show.

SINGLE BREED CUPS—*contd.*

Donor	Cup and Event	Winner	Cash Rs.
Ingram Skinner Estate, Palwal, Punjab	The Quirke Challenge Cup for the best Hissar-Hansi bull	Kanwar Singh, Bhor (Rohtak)	100
Shriman Rao Raja Bahadur of Sikar (Rajputana)	The Sikar Challenge Cup for the best Hissar-Hansi cow	Kaman, Patiala . . .	50
Cattle Breeding Association, Tehsil Bhiwani, Hissar	The Sir Chhotu Ram Challenge Cup for the best Hissar-Hansi heifer	Devta Sarupe, Rewari (Gurgaon)	50
Maharaval Shree Sir Indrasinhji, Partap Sinhji, Raja of Bansda	The Bansda Challenge Cup for the best Kankrej cow	The Manager, Northcote Cattle Farm, Chharodi	50
H. H. The Maharaja of Jodhpur	The Jodhpur Challenge Cup for the best pair of bullocks of Nagori breed	H. H. The Maharaja Sahib Bahadur, Bharatpur	100
Shriman Rao Raja Bahadur of Sikar (Rajputana)	The Sikar Challenge Cup for the best Nagori cow	Moti Singh, V. Nadbae, Bharatpur	50
H. H. The Maharaja of Datia .	The Datia Challenge Cup for the best Red Sindhi cow	Allahabad Agricultural Institute, Allahabad	50
H. H. The Raja Sahib of Keonthal	The Keonthal Challenge Cup for the best Sahiwal bull	K. S. Sardar Dost Mohd. Khan, Jahangirabad, Multan	100
*H. H. The Nawab Ruler Bahadur of Bahawalpur	The Bahawalpur Challenge Cup for the best Sahiwal cow	Ch. Shauq Mohd. Khan, Jahania (Multan)	50
S. Harinder Singh Sandanwalla, Rais of Raja Sansi, District Amritsar	The Sandanwalla Challenge Cup for the best Sahiwal young cow	Ch. Shauq Mohd. Khan, Jahania (Multan)	50
The Hon'ble Rai Bahadur Ram Saran Das, Lahore	The Ram Saran Das Challenge Cup for the best Sahiwal heifer	K. S. Sardar Dost Mohd. Khan, Jahangirabad, Multan	50
The District Board, Lyallpur .	The Lyallpur District Board Challenge Cup for the best Murrah bull	Pinjrapole Society, Delhi .	100
Sardar Bahadur Sobha Singh, Rais & Landlord, New Delhi	The Sobha Singh Challenge Cup for the best Murrah cow	Suleman, Nagana (Rohtak) .	50
Ch. Sohan Lall, Member, District Board, Ferozepore	The Walker Challenge Cup for the best Nili bull	R. S. Ch. Mahla Singh, Bahadur Nagar, Montgomery	100
The District Board, Ferozepore, Punjab	The Amin-ud-Din Challenge Cup for the best Nili cow	R. S. Ch. Mahla Singh, Bahadur Nagar, Montgomery	50
Mian Mohd. Zarif, Tehsil Chunian, District Lahore	The Sir Chhotu Ram Challenge Cup for the best Ravi bull	Sant Mohindar Singh (Amritsar)	100
Sardar Nand Singh and Lala Chuni Lal, Tehsil Kasur, District Lahore	The Sir Sikandar Hayat Challenge Cup for the best Ravi cow	Kahan Singh, Lyallpur . .	50

BREED CHAMPIONSHIP CUPS

Donor	Cup and Event	Winner	Cash Rs.
The Times of India, Bombay .	The Times of India Challenge Cup for the best animal of Bhagnari breed	Usman, Jaskani of Rakh Mohd. Pur	100
†H. E. H. The Nizam of Hyderabad	The Hyderabad Challenge Cup for the best animal of Deoni breed	Hanmanth Rao, Hyderabad-Deccan	100
The District Board, Mianwali, Punjab	The Mianwali Diatrict Board Challenge Cup for the best animal of Dhanni breed	Ghulam Mohd. Chattal (Jhelum)	100
H. H. The Nawab Sahib of Junagadh	The Junagadh Challenge Cup for the best animal of Gir breed	Willingdon Cattle Breeding Farm, Junagadh	..
Lala Madho Ram, Chandiwala, Amritsar	The Walker Challenge Cup for the best animal of Hariana breed	Sheo Dan, Dakhla (Rohtak) .	100
†Employees of the Government Cattle Farm, Hissar	The Branford Challenge Cup for the best animal of Hissar-Hansi breed	Superintendent, Government Cattle Farm, Hissar	..
*H. H. The Nawab of Bhopal .	The Bhopal Challenge Cup for the best animal of Malvi breed	Younus Hussain, Bhopal .	100

* Cups provided with miniatures.
† Cups received after the 1940 show.

BREED CHAMPIONSHIP CUPS—*contd.*

Donor	Cup and Event	Winner	Cash
			Rs.
*H. H. The Maharaja of Alwar .	The Alwar Challenge Cup for the best animal of Mewati breed	Bhuri, Widow of Ranjit, Alwar	100
H. H. The Maharaja of Jodhpur	The Jodhpur Challenge Cup for the best animal of Nagori breed	Moti Singh, V. Nadbas, Bharatpur	100
H. H. The Maharaja Holkar of Indore	The Holkar Government Challenge Cup for the best animal of Nimari breed	Taluka Development Agricultural Association, Jalgaon	100
H. H. The Maharaja of Rajpipla	The Rajpipla Challenge Cup for the best animal of Rath breed	Pinjrapole Society, Delhi .	100
*H. H. The Nawab Ruler Bahadur of Bahawalpur	The Bahawalpur Challenge Cup for the best animal of Sahiwal breed	Military Dairy Farm, Ferozepore Cantt	..
†Lt.-Col. C. E. Macguckin, Inspector, Military Dairy Farm, Lahore Cantt	The Macguckin Challenge Cup for the best animal of Murrah breed	Suleman, Nagana (Rohtak) .	100
The District Board, Montgomery (Punjab)	The Montgomery District Board Challenge Cup for the best animal of Nili breed	R.S. Ch. Mahla Singh, Bahadur Nagar (Montgomery)	100
†Mr Abdul Munim, Rais-I-Azam, Member, District Board, Batala	The Walker Munim Challenge Cup for the best animal of Ravi breed	Sant Mohindar Singh (Amritsar)	100

CHAMPIONSHIP CUPS

Donor	Cup and Event	Winner	Cash
H. H. The Maharaja of Dhar .	The Dhar Challenge Cup for the best draught type bull	Karam Ali (Jhelum) . . .	125
H. H. The Maharaja of Ratlam	The Ratlam Challenge Cup for the best draught type cow	Ghulam Mohd. of Chattal (Jhelum)	125
H. H. The Maharaja Dhiraj of Patiala	The Patiala Challenge Cup for the best milch type bull	Livestock Officer in Sind, Sakrand	..
H. H. The Maharaja Dhiraj of Patiala	The Patiala Challenge Cup for the best milch type cow (I)	Military Dairy Farm, Ferozepore Cantt	..
*Lala Ladli Parshad, Rais, Delhi	The Radha Mohan Memorial Challenge Cup for the best milch type cow (II). Open to animals of private breeders	Nathu Lalji Charity Trust Cattle Breeding and Dairy Farm, Mulund	125
†H. H. The Maharaja of Bharatpur	The Bharatpur Challenge Cup for the best general utility bull	The Manager, Northcote Cattle Farm, Chharodi	125
†Lala Shankar Lall, Millowner, Delhi	The Madan Mohan Lall Challenge Cup for the best general utility cow	Superintendent, Government Cattle Farm, Hissar	..

SUPREME CHAMPIONSHIP CUPS

Donor	Cup and Event	Winner	Cash
The District Board, Jhelum, Punjab	The Saidullah Khan Challenge Cup for the best Buffalo bull in the Show	Military Dairy Farm, Ferozepore Cantt	..
H. H. The Maharaja Gaekwar of Baroda	The Baroda Challenge Cup for the best Buffalo cow in the Show	R. S. Ch. Mahla Singh, Bahadur Nagar (Montgomery)	150
H. E. H. The Nizam of Hyderabad	The Hyderabad Challenge Cup for the best bull in the Show	Livestock Officer in Sind, Sakrand	..
H. H. The Maharaja Scindia of Gwalior	The Scindia Challenge Cup for the best cow in the Show	Military Dairy Farm, Ferozepore Cantt	..
†H. E. The Viceroy and Governor General of India	The Marquess of Linlithgow Challenge Cup for the best animal in the Show	Military Dairy Farm, Ferozepore Cantt	..

* Cups provided with miniatures.
† Cups received after the 1940 show.

OTHER SPECIAL PRIZES

Donor	Cup and Event	Winner	Cash Rs.
†The Punjab Cooperative Cattle Breeding Society, Amritsar	The Punjab Cooperative Cattle Breeding Society Cup for the best cow bred by Cooperative Cattle Breeding Societies in India	Usman Jaskani of Rakh Mohd. Pur	..
The Bombay Gowrakhshak Mandli	The Bombay Gowrakhshak Mandli Shield for the best cow reared and bred in Gowshala or Pinjrapole	Pinjrapole Society, Delhi .	..

MILKING COMPETITION

Donor	Cup and Event	Winner	Cash Rs.
Sir Datar Singh, Montgomery Dairy Farm, Montgomery	The Sir Datar Singh Challenge Cup for the highest milk yielding cow	*1st prize*: Military Dairy Farm, Ferozepore Cantt	..
		2nd prize: Ch. Shauq Mohd. Khan, Jahania, Multan	50
		3rd prize: Ch. Shauq Mohd. Khan, Jahania, Multan	15
	Best milking buffalo cow . .	R. S. Ch. Mala Singh Lessee, Bahadurnagar, District Montgomery	50
J. R. Patel, Cattle Dealer, Karachi	The Jehangir Patel Challenge Cup for the highest milk yielding Red Sindhi cow	Imperial Dairy Institute, Bangalore	..

STUDENTS' JUDGING CONTEST

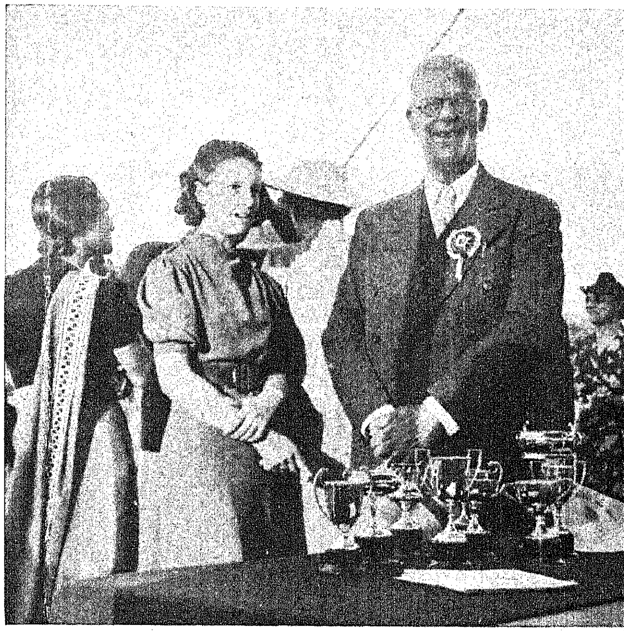
Donor	Cup and Event	Winner	Cash Rs.
†Polson Limited, Bombay .	Shield for the best team of student judges	*1st prize*: The Punjab Agricultural College, Lyallpur. (Team A)	75
		2nd prize: The Punjab Agricultural College, Lyallpur. (Team B)	50
		3rd prize: Imperial Veterinary Research Institute, Izatnagar. (Postgraduate Team)	25

BULLOCK CART COMPETITION

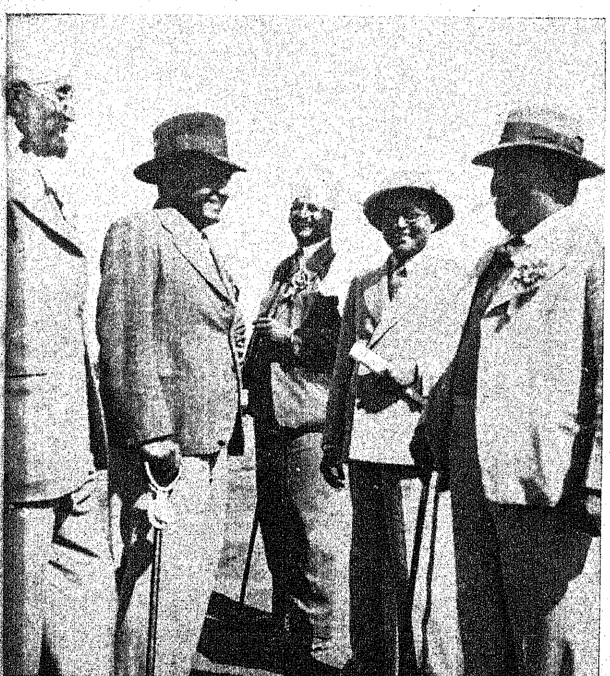
Donor	Cup and Event	Winner	Cash Rs.
The Indian Roads Congress .	(I) A two-bullock rubber-tyred cart for the best pair of bullocks	*1st prize*: Phoolo, of Parwar (Rohtak)	..
	(II) A single-bullock rubber-tyred cart for the best pair of bullocks	*2nd prize*: H. H. The Maharaja Sahib Bahadur of Bharatpur	..

† Cups received after the 1940 show.

Interested visitors



Mr A. E. Slater of the Mission Poultry Farm, Etah looking happy with his cups won at the Poultry Sho



. Ghulam Hasan, Mr M. I. Malik, Mr Tora Baz Khan, Mr S. C. Roy and Mr B. N. Handa

Visitors from the Punjab envious of Madras, whose Ongole cattle are thriving in Brazil

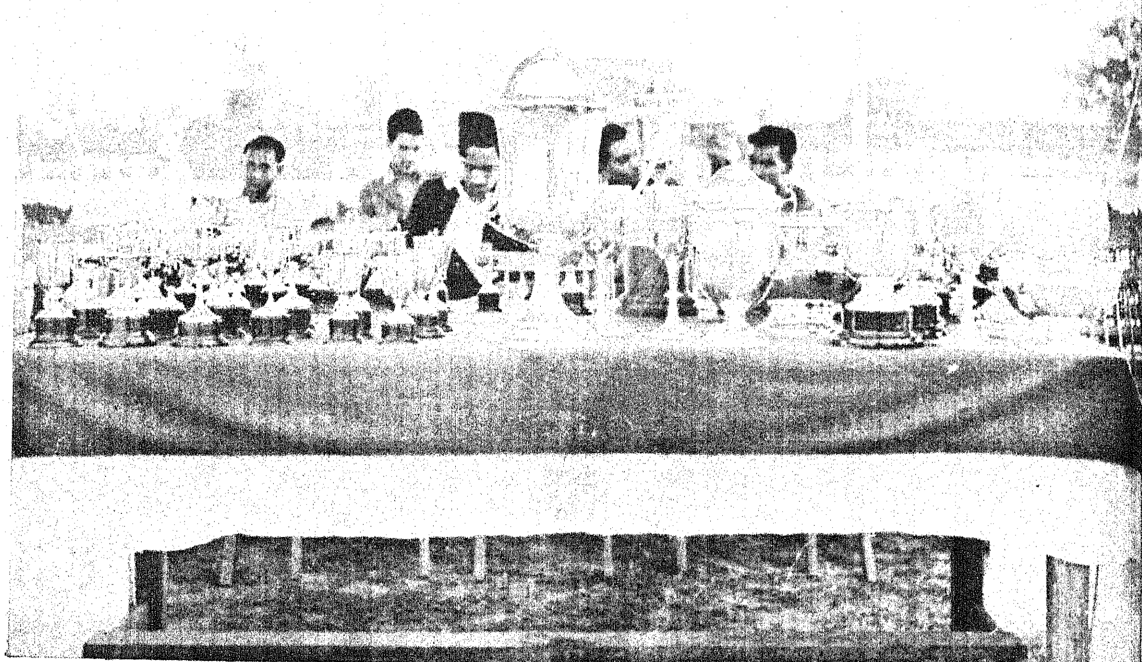


Photo Service Co.

Poultry Show cups

[PLATE 63

Lady Lloyd distributing the prizes at the Poultry Show

Photo Service Co.

VETERINARY WORK IN THE NORTH-WEST FRONTIER PROVINCE

By M. Abdul Wahid Khan, L. V. P., P. G. (Mukteswar)
Veterinary Assistant Surgeon, Peshawar

THE Veterinary Department maintains a network of 75 hospitals in the North-West Frontier Province. Each hospital is in the charge of a qualified veterinarian, but there are a few hospitals with experienced compounders in charge, because local qualified veterinarians are not available. This deficiency, however, is being gradually made up as our stipendiary students return duly qualified from various veterinary colleges in India.

Sick animals brought to the hospitals get absolutely free treatment. Most of the hospitals have sufficient accommodation for indoor patients as well, and efforts are being made to convert all dispensaries into up-to-date hospitals. The hospitals are financed by local bodies with grants-in-aid from the provincial Government. Besides, there are two outlying dispensaries with each hospital, and thus veterinary aid is provided for zemindars in even the remote corners of the province.

Prevention of contagious diseases

Every patwari has been given printed cards by the Department to use in reporting to the nearest civil veterinary hospital the occurrence of contagious disease among animals in his jurisdiction. On receipt of this information the head of the hospital goes to the place of outbreak, diagnoses the disease and indents serum or vaccine from the provincial veterinary laboratory. It is sent to him without the least delay. He then performs preventive inoculations and takes other necessary precautions of segregation and disposal of cases to check the outbreak. Where the veterinary assistant has any difficulty in the diagnosis of the disease, he sends necessary material to the provincial veterinary laboratory for confirmation of the disease. Preventive inoculations are also performed by the hospitals against certain diseases, especially rinderpest and hæmorrhagic septicæmia which have proved very effective in reducing the number and severity of outbreaks.

Livestock improvement

Livestock improvement is one of the main activities of the Civil Veterinary Department, and although the Department aims at the improvement of all animals of economic importance, its efforts are primarily directed towards cattle improvement. The method of improvement is chiefly that of grading. At present there are 425 bulls of approved breeds located with interested zemindars of the province. The keepers of these bulls are known as *darindas* and they are expected to allow free service of the bulls to the cows brought to them for covering. A complete record of the coverings and progeny of each bull is kept by the hospital and this is occasionally checked by the head of the Department and certificates are issued to the owners of the progeny of subsidy bulls. The same applies to sheep, goats, camels and buffaloes as well. As for equine breeding, horse and donkey stallions are located in civil veterinary hospitals. Mares and female donkeys in heat are brought to the hospitals for covering. A covering register is kept by each hospital and progeny certificates on printed forms are issued to the owners when the animals foal. As regards poultry-breeding, the conditions are slightly different. A few model poultry farms have been established in civil veterinary hospitals where at present one breed of birds, viz. White Leghorn, is kept. The eggs from the birds are given to zemindars at a nominal price for hatching and it is the duty of the hospital to see that eggs are actually hatched. The scheme has been introduced only recently and is running quite successfully.

Veterinary investigation

There is an investigation officer working under a scheme financed by the Imperial Council of Agricultural Research. His job is to investigate certain disease conditions and suggest practical means to combat them. He surveys and studies veterinary problems

special to local conditions and suggests suitable measures to tackle them successfully. He has done some useful work on rinderpest, sheep pox and liverfluke diseases, all of which are very common in this province.

Veterinary propaganda has been started only very recently. It consists of the following :

(1) Organization of demonstration stalls at cattle fairs, and other important public functions. Here departmental charts, photographs, specimens, etc., dealing with various aspects of animal husbandary are arranged in an attractive manner and demonstrated to the zemindars.

(2) Arranging lectures at cattle fairs.

(3) Broadcasting talks from the All-India Radio station at Peshawar on the useful activities of the Department.

ORISSA

By S. Solomon, I.C.S.
Director of Development, Orissa

Two students, one an agricultural officer in the Department and one recruited from outside, have been deputed for training in mycology and entomology at the Imperial Agricultural Research Institute, New Delhi, with a view to appointing them as Mycologist and Entomologist under the Orissa Government. Another student with a British degree has been sent for training in horticulture at the Lyallpur College of the Punjab University, so that the Agricultural Department might be strengthened by a qualified horticulturist.

Sugarcane crushing plant

An interesting experiment has been started by demonstrating the crushing of sugarcane by power-crushing plant. Although it is now too early to come to any conclusion regarding the results of the scheme, it would seem that the idea has caught on and large numbers of cultivators are coming forward to have their cane converted into *gur* by this process. If the scheme proves to be a success, the experiment will be extended on cooperative lines.

On the veterinary side, the Utkal Gomangal Samiti continues to do good work and there is an increasing demand for the service of its bulls, a number of hosts to maintain the animals coming forward from the interior of the districts. During the last quarter one new buffalo-bull centre and one bull breeding centre were added, bringing the total number of centres in the province to 44 bull and 5 buffalo-bull centres.

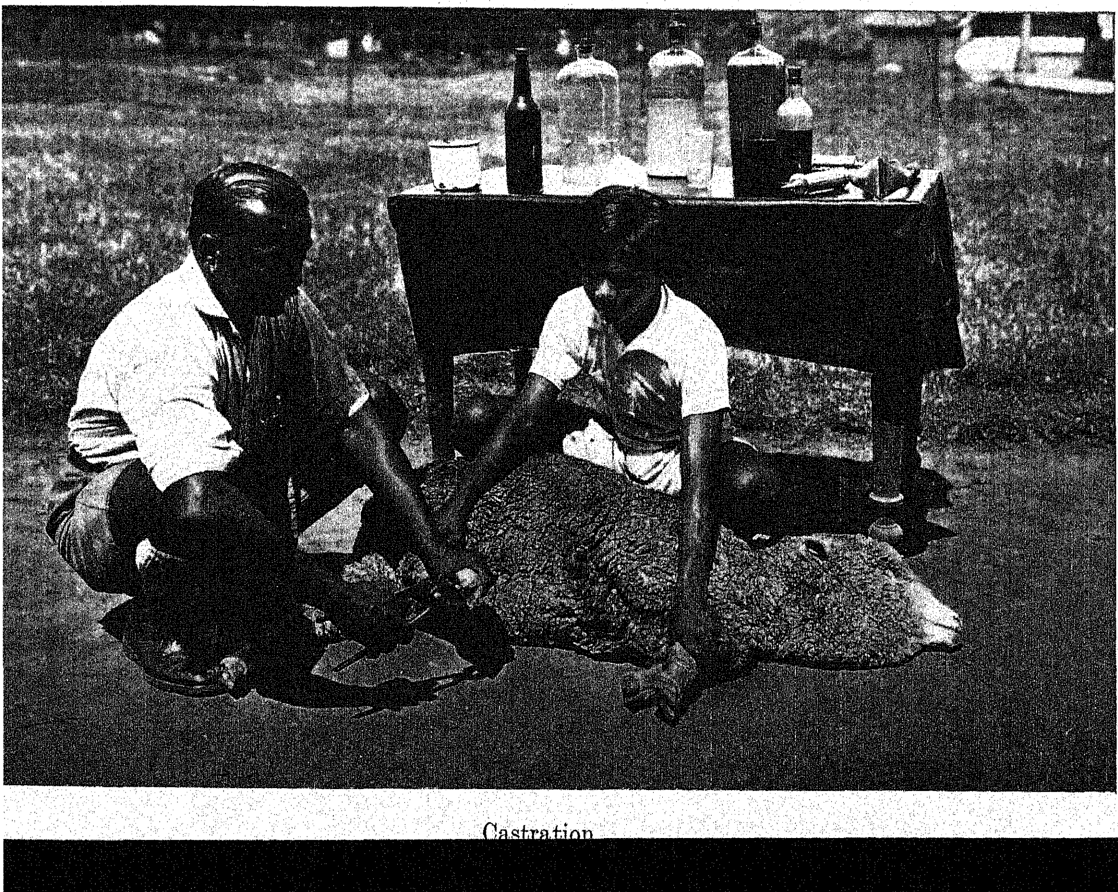
A rather alarming symptom which came to light during the quarter was the extensive hold that tuberculosis and Johne's disease seem to have got on the cattle in the Government Farm at Cuttack. A large number of cattle at the farm reacted positively to one or both of these diseases, posing a serious problem to the Farm authorities.

Prospects for artificial insemination

An officer of the Agricultural Department, who will be completing his livestock training at Mukteswar and Izatnagar, is being deputed, on his way back to the province, to the Allahabad Agricultural Institute to study the problem of artificial insemination which, if the difficulties can be successfully tackled, holds out prospects of a more rapid progress in improving the breed of cattle in a poor province which cannot afford to maintain an unlimited number of bulls of good pedigree.

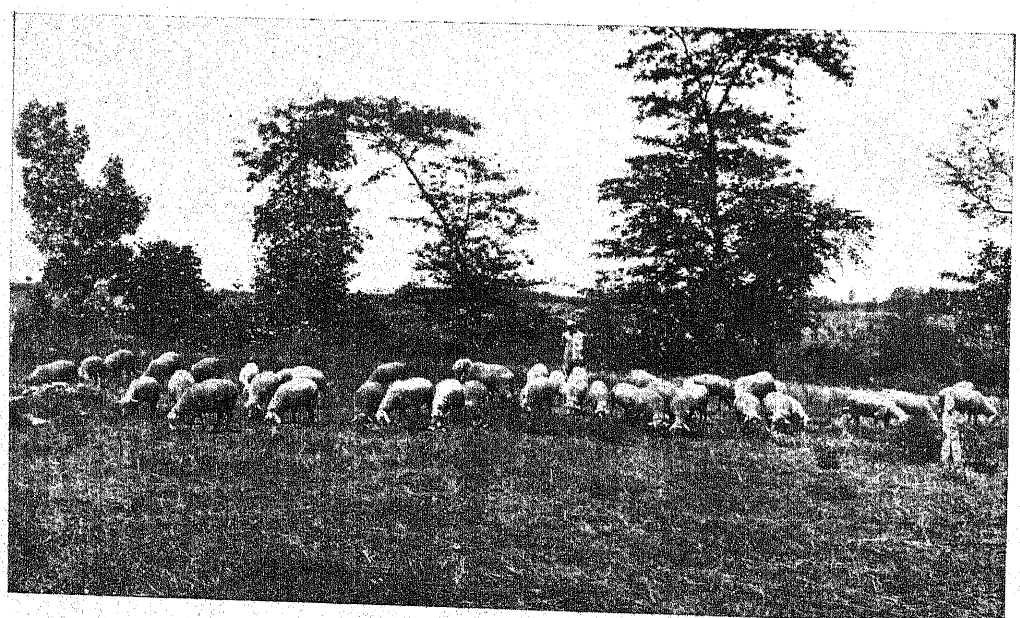
On the cooperative side, a tobacco growers' production and sales society has been organized in the Ganjam district. This is the first society of its kind in the province for tobacco, and its progress will be watched with interest.

A ram being medicined at Hebbal



Castration

Goats at Hebbal presented by Her Highness the Yuvarani of Mysore



Cross-bred sheep at Hebbal

MYSORE

By M. Vasudevamurthy, B. Ag.

Secretary, the Mysore Agricultural and Experimental Union, Bangalore

The operation of the Pest Act for the control of the coffee stem-borer has been extended and the coffee cess has been continued for another ten years, with the support of the Representative Assembly and the Legislative Council, to finance coffee research at Balehonnur. Destruction of infested coffee bushes to control the coffee stem-borer made considerable progress during the year. Some idea of the magnitude of the work can be gauged from the fact that the number of bushes destroyed during 1938-39 was 3,282,445 and in 1939-40, 4,253,192.

The Cigarette Tobacco Safeguarding Act came into operation during the year, the most important provisions of the Act being the licensing of barns and of tobacco nurseries. Suitable conditions relating to end selection and spraying are insisted upon in the licence for tobacco nurseries.

Beekeeping

As a result of the demonstration of modern methods of beekeeping in several areas in the state, a Beekeepers' Cooperative Society was started at Saklespur, as previously reported, with substantial support from Government. The society has done splendid work within six months of its start. It has collected 7,000 lb. of honey for the market. The society has a very large membership and clientele.

Concentrated and extensive work was done in the introduction of improved varieties of paddy in all parts of the State. The *malnad* comprising the hilly areas of Mysore with heavy rainfall contains nearly four lakhs of acres under paddy, most of which is purely rain-fed. It was all along considered as an area of coarse paddy. S 661—a selection from GEB 24 fine paddy—was introduced into the *malnad* on a very large scale. It has done very well. It is therefore proposed to redouble efforts to increase the production of paddy in the *malnad*.

Tractor service

Power-farming is becoming popular. The Department has purchased two tractors for letting them on hire to the ryots for ploughing their fields. In view of the wide popularity of these tractors, the Government of Mysore has sanctioned the purchase of two more tractors during the current year. As the season for ploughing is limited in the purely rain-fed areas, and as there is scope for ploughing in any part of the year in the Irwin Canal area, there seems to be infinite scope for extending the benefits of power-farming to the ryots.

Local resources

Owing to the wide adoption of iron ploughs the local manufacture of spare parts of improved ploughs and of six-tyned cultivators has been undertaken by small workshops and village blacksmiths. The stoppage of the import of German sprayers has given an impetus to the manufacture of sprayers locally. It is gratifying that Messrs Annapurna Cooker Company have been able to supply the indents of the Department for sprayers. A new resin paste has been manufactured by the Government Soap Factory as a substitute for casein adhesive in the preparation of spraying mixtures.

Organic manures

Owing to the cheapness of ammonium sulphate (Rs. 6 per cwt.) before the war, sugarcane growers had got into the habit of using very large quantities for raising heavy crops of sugarcane. Ammonium sulphate having doubled in price due to the war, experiments were laid down to find out how much of the nitrogen required for the sugarcane could be supplied with advantage through organic manures. Experiments conducted on the subject have clearly proved that $\frac{1}{2}$ to $\frac{3}{4}$ of the nitrogen requirements of sugarcane could be supplied in the form of organic manures without detriment to the crop and that there

is no advantage in giving more than $\frac{1}{4}$ to $\frac{1}{3}$ the nitrogen requirements of cane in the form of ammonium sulphate. The demonstration section of the Department is busy acquainting the ryots with the preparation and utilization of compost from sugarcane trash so as to prepare large quantities of organic manure in the field.

Veterinary service

Mysore ranks high in the list for provision of veterinary aid to the cattle population. There are 82 veterinary inspectors, providing one veterinary Inspector for every 50,000 head of cattle. There is an efficient system of reporting epidemics. There are nearly 116 cattle fairs held all over the state to provide facilities to purchasers of Mysore cattle.

To improve the quality and yield of wool, Mysore has been adopting the system of cross-breeding of country sheep with the Merino for several years. A fresh impetus has been given to the work by the large flock of pure-bred Merino imported by the state. It is a matter for gratification that over a dozen lambs were born to the pure-bred Merino flock at Hebbal and the locally born lambs are quite as healthy and more disease-resistant than their imported parents. To three flock-owners who have raised the grade of their flocks to about $\frac{7}{8}$ Merino, three pure-bred Merino ram lambs born at Hebbal were issued at concessional prices.

Goat-breeding has been commenced at the Hebbal Farm with a small flock of English goats which were kindly presented to the Farm by Her Highness the Yuvarani. The English goats are yielding about 3 lb. of milk per day.

In addition to the Ajjampur Cattle-breeding Station with a strength of 1,000 cattle, the Hunsur Cattle-breeding Station started work during the year with 500 cattle. A large number of stud bulls and stud bull calves were issued from these farms.

The Hebbal Napier grass, which is a purely rain-fed and drought-resistant variety, is increasing in popularity with the ryots and has spread over hundreds of acres.

Twelve poultry demonstration centres were working throughout the year. The demand for hatchable eggs and chickens has increased far beyond the capacity of the 12 centres. The fowl population in each centre has therefore been raised to 100 so as to meet the demand from the public for hatchable eggs.

ASSAM

By S. Chakrabarti, B.A.(Hons.)

Assistant, Office of the Director of Agriculture, Assam

A MEETING was held in December last at Shillong to consider several schemes for the development of the production and marketing of Assam jute. The Hon'ble Maulavi Munawwar Ali, Minister for Agriculture, Assam, presided over the meeting, which was attended by Mr D. L. Mazumdar, Secretary, Indian Central Jute Committee; Mr A. S. Low, Senior Marketing Officer, Indian Central Jute Committee; Mr S. Gohain, Deputy Secretary to the Government of Assam; Dr S. K. Mitra, Director of Agriculture, Assam; and Mr L. K. Handique, Senior Marketing Officer, Assam. Assam Jute at present sells at a lower price than Bengal jute because of its supposed inferiority. This stigma on Assam jute is, however, not justified by facts. In reality, *Assam produces some of the finest jute that is marketed in India or abroad.* The meeting, therefore, came to the unanimous decision that this unfounded stigma should be removed by means of propaganda, grading and systematic marketing. The meeting was assured by Mr Low that the disposal of graded Assam jute would not at all be difficult.

With this object in view, the meeting agreed

that a grading station should be established in Assam during 1941-42, where the work would be carried on through a cooperative jute sales society. The meeting also considered the possibility of standardizing weights and measures and in the course of discussion the Hon'ble Minister informed the meeting that the Government of Assam had under consideration a bill for standardization of weights and measures. In this connection, Mr Mazumdar stated that the main difficulty in the way of standardization was the absence of an adequate supply of a particular metal which was required for the manufacture of standard balances and weights.

The Hon'ble Minister also informed the meeting that the Government of Assam had under its consideration another bill—the Regulated Markets Bill—for the establishment of regulated markets in Assam. The meeting also considered the question of supplying improved jute seeds to the growers with the help of a permanent advance from the Indian Central Jute Committee. After some discussion it was agreed that the work should be taken up on an experimental basis. Lastly, the Assam scheme for the establishment of a jute research sub-station was considered and it was agreed that a revised scheme should be submitted to the Indian Central Jute Committee for sanction.

Tea culture in 1939

In his report on tea culture in Assam during 1939, recently published, the Director of Agriculture states that owing to the restriction scheme the general condition of the industry improved although the prices obtained were not quite up to expectation due to the outbreak of war, which interfered with the export of tea to foreign countries. At the close of the year there were 1,126 tea gardens in Assam, compared to 1,120 of the previous year, of which 396 were owned by Indians. The total area under tea decreased from 439,134 acres of the previous year to 438,251 acres. The area plucked decreased from 402,819 to 402,379 acres and represented 92 per cent of the total area under tea—as in the previous year. The daily average number of labourers employed in the tea gardens during 1939 was 538,294 against 520,932 of the previous year. The incidence of the plucked area under tea to labour came to ·75 acre per man against ·77 of the previous year. The total outturn of tea in the province during the year was 252,347,358 lb. of black and 572,175 lb. of green tea against 260,248,898 lb. of black and 808,493 lb. of green tea of the previous year. The provincial average outturn of manufactured tea per acre decreased from 648 to 627 lb.

Crop substitution

Aman paddy (deep water paddy), the mainstay of the people of the districts of Sylhet and Cachar, has in recent years become extremely precarious owing to recurrence of floods. While the Department of Agriculture is carrying on researches for the evolution of flood-resistant varieties of this paddy, steps are also being taken for spreading the cultivation of a substitute crop—a variety of spring paddy (known locally as *boro*) which is grown on a comparatively small area in the districts named above. As it is grown during the dry months its cultivation is restricted to the margins of *bils* (natural depressions which retain water even during winter months). But given adequate irrigation facilities, its cultivation can be extended all over the vast *aman*-growing tracts, which at present remain practically uncropped once in three years.

The Department of Agriculture has been endeavouring to tackle the irrigation problem by employing irrigation pumps. The first attempt in this direction was made in 1931 with an irrigation pump driven by a kerosene oil engine, but the trial proved too expensive. In 1934, another trial was made with a centrifugal pump driven by a Diesel engine and the trial proved very successful and an area of 300 acres was irrigated at a cost of Rs. 3 per acre. Since then, the Department of Agriculture has been conducting demonstrations with pumps of this type and the results have been more or less satisfactory. These demonstrations will be continued till the cultivators are thoroughly convinced that by growing a substitute crop of *boro* paddy in *aman* areas with the help of these pumps they can substantially improve their lot and escape the

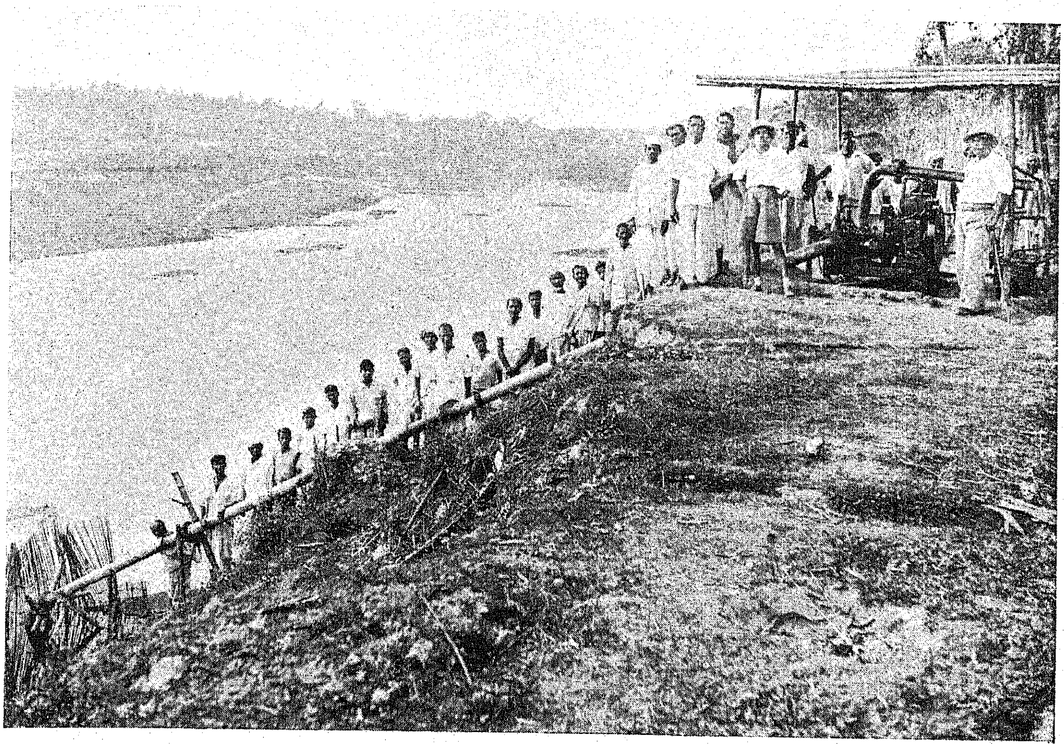
miseries consequent on the repeated failure of the *aman* crop. The Department has also made arrangements for the sale of these pumps through the hire-purchase system. The pumping sets are not very costly, being priced at about Rs. 1,500 each, and many zemindars, who own big *khamar* land (land under cultivation), can easily buy them. Even the ordinary cultivators can purchase them through co-operative societies.

Livestock improvement

Livestock improvement work in Assam comprises the grading up of local cattle by crossing them with imported cattle of superior breeds and the employment of the cross-bred ones in grading up still more locals. These operations are conducted in Assam in the various Government cattle-breeding farms, jail dairies, village breeding centres, grazing reserves, through the Livestock Improvement Association of Assam, several municipalities and tea estates and through individuals interested in the improvement of animal husbandry. An idea of the progress of work in this direction can be gained from the fact that up to 31 March 1940, Government breeding bulls have served a total number of 25,972 privately owned cows and the staff of the Department of Agriculture have castrated more than 10,000 weedy bulls. This is not an insignificant record considering the limited resources of the Livestock Section and the fact that livestock improvement work was seriously taken up in Assam only from the year 1929-30. The Livestock Section of the Department has also obtained very good results in breeding cattle of good physique and cows of high milk yield. At one of its farms—the Upper Shillong Farm —from a herd of 22 cross-bred cows an average milk yield of 7,365 lb. per lactation was obtained from each cow during 1939-40, the highest individual yield being 11,662 lb. Recently, a three-year scheme for animal nutrition has been sanctioned—to be financed jointly by the Imperial Council of Agricultural Research and the Assam Government—and work under the scheme is expected to start soon.

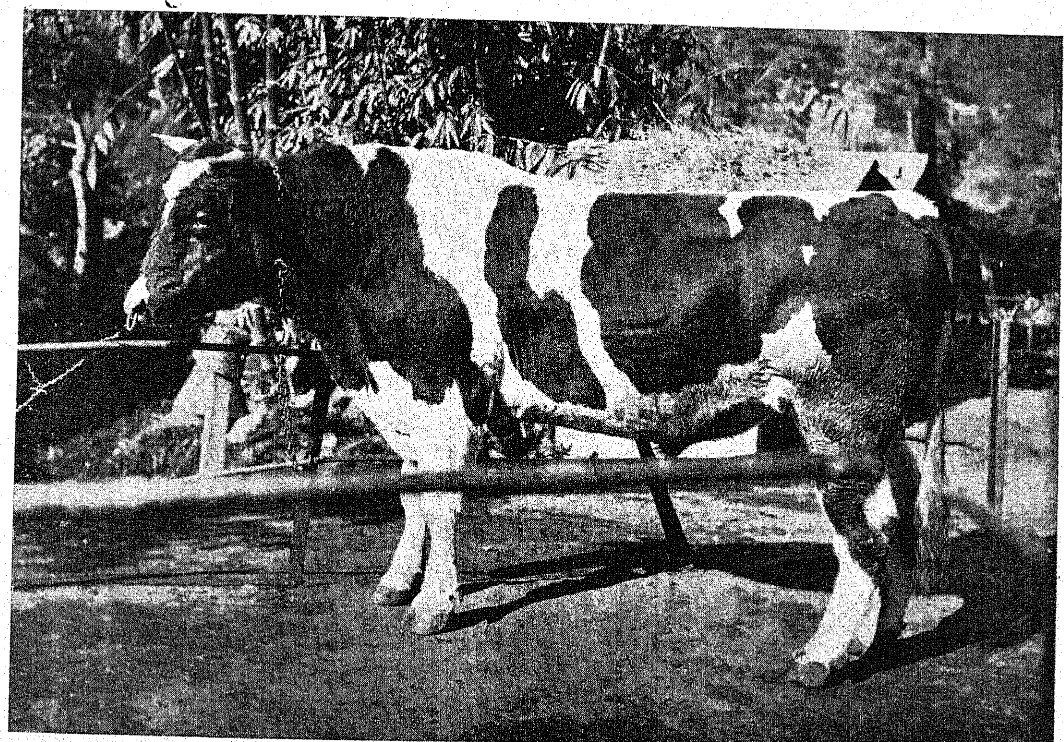
Opium prohibition

In a Government resolution published recently, it is revealed that as a result of the introduction of opium prohibition in Assam the number of opium passes has decreased from 29,791 permanent and 575 temporary at the beginning of the year 1939-40 to 16,617 permanent and 265 temporary at the close of the year. The total monthly ration has also come down from 14 maunds and 38 seers to 5 maunds and 16 seers. The prohibition scheme, now in operation, provides that all opium shops in the 'included areas' of the province will be closed from 1 March 1941 and opium passes in future will only be issued in very special cases strictly on medical grounds. It is also stated in the resolution that about 40 per cent of the addicts treated in the 'total prohibition area' have not reverted to the opium habit. There is no doubt that prohibition in Assam has been attended with some measure of success, but the increase in the consumption of *ganja*, liquor, and smuggled opium is a disquieting feature. In addition to increasing the Excise staff, the Government of Assam, states the resolution, has of late approached several provincial Governments and states from which contraband opium is reported to have been smuggled into this province with a request for a joint conference to devise ways and means for checking smuggling. But it is felt that sustained and effective propaganda for creating a strong public opinion which will denounce and discountenance the nefarious trade of the smugglers is necessary for the success of prohibition. Public help and cooperation are necessary if the effects of a scheme which has cost the public a colossal sum in the loss of revenue as well as extra expenditure are to be stabilized.



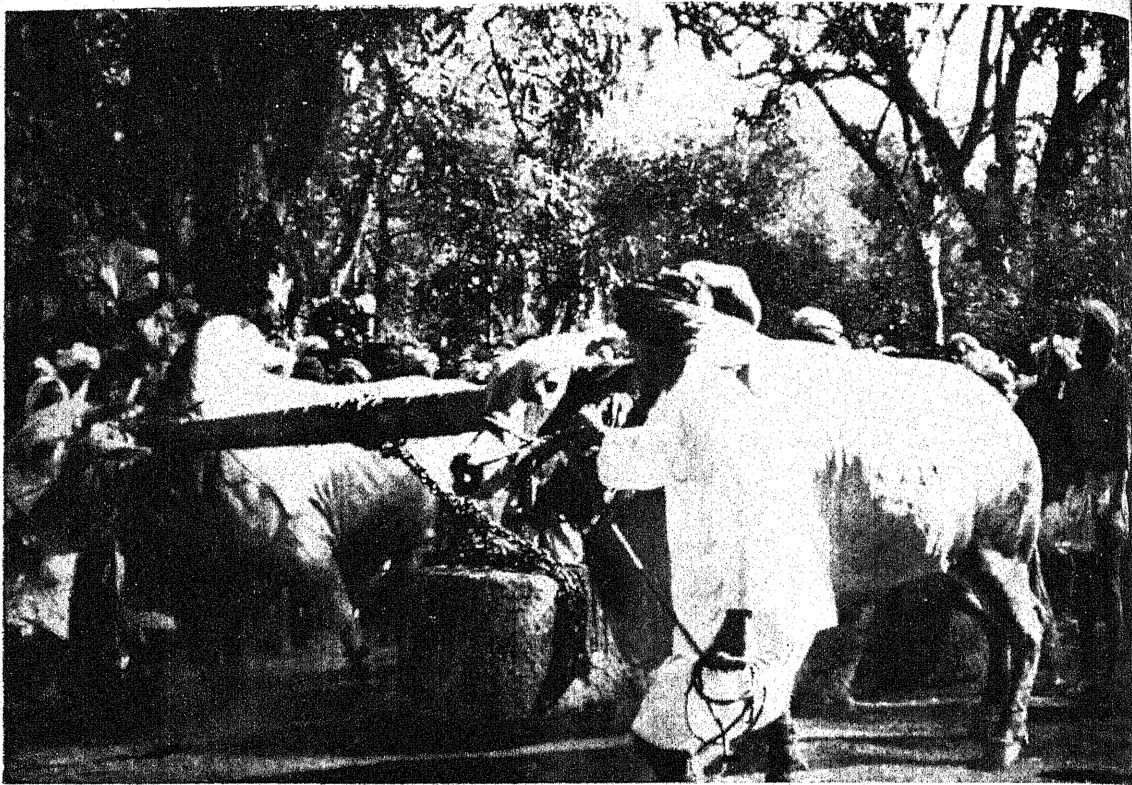
S. Chakrabarti

Water is being drawn by a power-driven pump for irrigating *boro* paddy in a nearby field

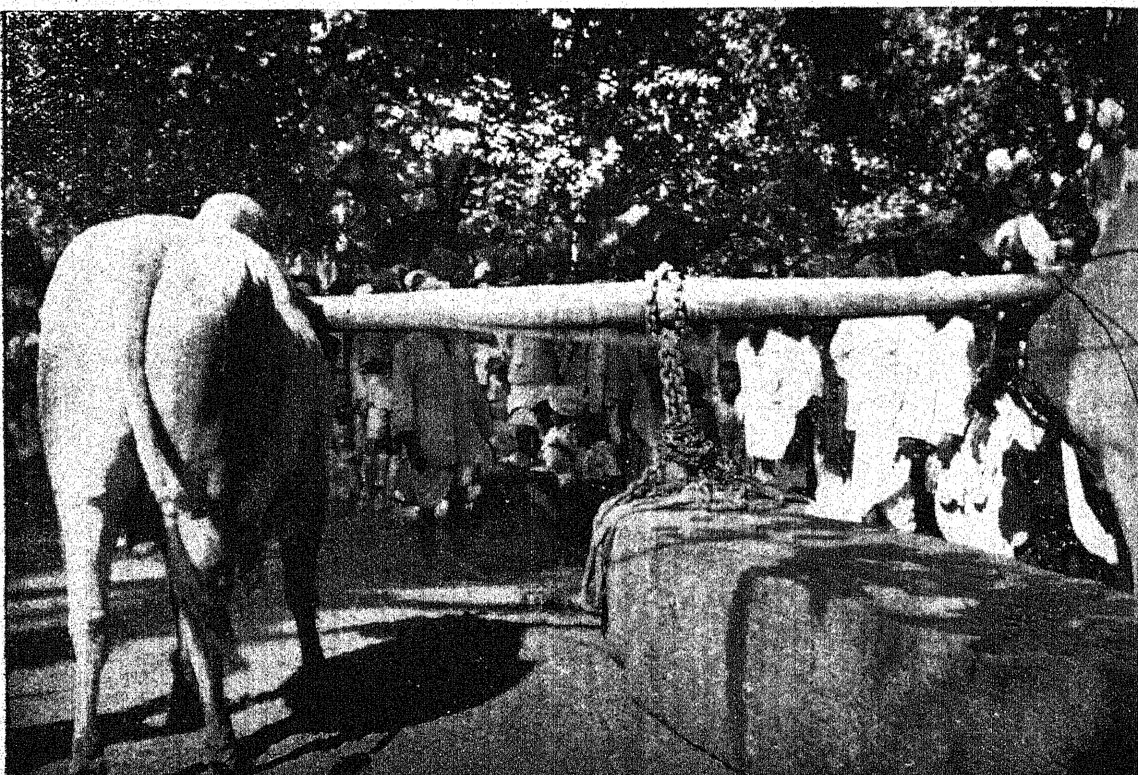


S. Chakrabarti

Master Goldicote—A four-year-old cross-bred bull belonging to Rai Sahib Sonadhar Das Senapati, of Shillong. Sire—Goldicote, British Friesian bull of the Government Cattle-breeding Farm, Upper Shillong



The sport of stone-dragging at Mahanandi, Kurnool district



SPORT OF STONE-DRAGGING AT MAHANANDI

By B. V. Chelapati Rao, G.M.V.C.

Touring Veterinary Assistant Surgeon, Panyam, Civil Veterinary Department, Madras

THE Kurnool district (its major portion being of red, rocky and black cotton soil), requires heavy animals for agricultural purposes. The Ongole breed of cattle is the main breed of cattle in this district, but there are many non-descript types.

The ryots judge the capacity of the working animals by their strength in pulling massive stones. This custom has gradually turned into a sport and prevails in each and every village. The animals are trained for the sport of stone-dragging and are entered for competitions which are usually held on festive occasions.

Mahanandi is a well-known pilgrim centre situated in the Nallamalai forest in Nandyal taluka. A large number of pilgrims visit this place for the *Sivaratri* festival (which falls usually in the month of February). This opportunity is availed of by a Committee of enthusiasts to hold a cattle show in conjunction with stone-dragging. A gold medal worth one sovereign is presented to the owner of the winning pair of bulls every year in the stone-dragging competition by the Trustee of Mahanandeswara temple at Mahanandi.

The Touring Veterinary Assistant Surgeon, Nandyal division, conducts the stone-dragging sport at Mahanandi with the assistance of a committee consisting of important ryots and officials. There is a permanent granite stone said to weigh about 3·2 tons. It is rectangular in shape and measures 11 ft. 2 in. × 2 ft. 3 in. × 1 ft. 10 in. There is a hole drilled into one end of the stone through which a crowbar is passed. Chains are connected to the crowbar and the yoke.

The time fixed for dragging the stone by a pair of bulls so yoked is half an hour and the pair of bulls which pulls the stone for the greatest distance during the allotted time is considered to have won the prize. The record distance that the stone has been dragged in half an hour is 211 ft. This occurred in 1939.

This kind of sport is a good test in endurance and pulling power and is very helpful to the ryots in the matter of selection of their animals.

The Month's Clip

BACTERIAL RING ROT THREAT

FROM now till harvest is the best time to detect the comparatively new but serious disease of potatoes known as bacterial ring rot (bacterial wilt and rot). Already the disease has caused serious losses in widely scattered localities in Canada and the United States and threatens further damage if not successfully controlled. Every potato-grower should keep a sharp look-out for this disease, states H. N. Racicot, Associate Plant Pathologist, Division of Botany and Plant Pathology, Dominion Department of Agriculture. The whole-hearted cooperation of every grower is essential for the suppression of this serious disease.

As a rule, diseased plants can be detected only late in the growing season. The symptoms are very variable but the most characteristic ones are described by H. N. Racicot in a Science Service Circular which may be obtained free on request from the Publicity and Extension Division, Dominion Department of Agriculture, Ottawa. The first symptoms are usually a rolling and wilting of the leaves which resemble the condition sometimes seen in healthy plants in dry weather. The affected leaves soon lose their normal green colour and feel thin and smooth to the touch. The whole or part of the leaves turns yellow, then brown, the affected parts eventually dying.

This necrosis or scorching of the leaves, which is frequently at the margin, somewhat resembles late blight but occurs only on the leaves of individual stems, while late blight is usually fairly evenly distributed in the field. The tips of stalks of the affected leaves wilt, while the basal part remains rigid. Eventually the whole leaf dies. One or more stems in a hill may wilt, while the remainder appear healthy. The stems that wilt are usually more or less stunted.

The tubers from diseased hills range from sound to completely rotten, but generally some of them show the crumbly, yellow rot, mainly in the region of the ring, that is so characteristic of the disease. Some of the apparently sound tubers contain the causal bacteria. It is imperative that diseased crops should never be used for seed; for not only do slightly infected tubers produce diseased plants, but they cause many healthy sets to become contaminated during the operations of seed-cutting and planting.

The most important means of control is the exclusive use of disease-free seed, but full details of what to do when disease has been discovered will be found in the circular.—*Press Note, Dominion Department of Agriculture, Canada*

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DO NOT NEGLECT CITRUS TREES

By E. C. Levitt, *Fruit Instructor*

IN some instances where citrus trees have failed to set a crop the growers have adopted a policy of reducing or even omitting manurial applications and neglecting essential work. While it is admitted that in many cases the financial circumstances of the individual make a reduction of expenditure compulsory at such times, any reduction effected should be the smallest possible.

Fruit trees are the growers' capital—and should be preserved in precisely the same way as any other capital investment, by regular expenditure on maintenance. Irregular maintenance causes production to become more costly.

The fact that a tree has failed to set a crop, as many have done this season, is no reason why that tree should be starved or neglected. The starved tree may quite conceivably bear a crop next season, but in doing so will be forced to draw heavily on its reserves of energy. Such a tree then becomes a much easier prey to parasites and root diseases if seasonal conditions are adverse. On the other

hand, the tree that is cared for in its off season will also produce a crop in the following year, and, having reserves well built up, is better able to withstand any adverse conditions that may be met with. Loss of capital is thus avoided to that extent.

Resoiling helps

Resoiling helps greatly in maintaining vigour, and is essential to best results in our shallow-soil districts, while in areas having deeper soils much benefit can often be derived from this operation also, depending on whether the trees have developed a deep-rooting system or not. In the majority of coastal soils the Rough Lemon stock develops roots very close to the surface. Resoiling can often be carried out when finance prevents a normal expenditure on fertilizers.

The benefits from the addition of new soil largely result from its humus content, therefore virgin surface soil is to be preferred. Avoid as far as possible the clay and gravel subsoils which contain little material likely to encourage root growth. Do not tip the soil under the trees so as to raise the soil in contact with the butt or to place the trees on mounds. Collar rots flourish when the soil covers the union of stock and scion, while mounds tend to dry out rapidly.

Keep the butt of the tree clear of soil where possible, and if the soil is also removed so as to expose the roots at the point of union with the trunk, so much the better. In land infected by Armillaria root-rot this treatment will materially extend the lives of the trees. To many it will seem that the uncovering of the root crown will retard growth, but, except in very young trees, this is incorrect.—*The Agricultural Gazette of New South Wales*, Vol. LI, Part 12, December 1940

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FOOD COLOURS

IT is well known that the appearance of some foodstuffs is improved by the addition of colouring material, provided the colour added is suitable both in shade and amount. An excessive amount of added colour or the use of unsuitable shades will result on the other hand in an unattractive appearance.

The addition of colouring agents to foods is subject to regulations based on the Food and Drugs Act, a Dominion statute, in order to provide control of both the amounts and kinds of food colours that may be used in Canada. In the laboratories of the Division of Chemistry, Science Service, Dominion Department of Agriculture, the analysis of many hundreds of samples of food materials yearly from packing houses and canneries, includes an examination for added colour, states C. E. Allan, Associate Chemist.

Colouring matters may be of mineral origin or extracted from vegetable material, but the quantity of both classes employed as food colours is exceeded by artificial colours manufactured from coal tar and derivatives.

Formerly, mineral pigments such as salts of copper, arsenic, zinc, and barium, as well as chalk and yellow ochre, were added to foods. This practice went out of date with the advent of pure food laws and is today but rarely attempted. The use of copper or copper compounds for colouring fruit and vegetable products is specifically prohibited.

There are available a number of naturally occurring colours that are harmless and which may be added to certain foodstuffs. Vegetable colours include beetroot (red); safflower (red); Saffron (orange-yellow); brazil wood (orange); annatto (yellow); turmeric (yellow); chlorophyll (green); and logwood (red). This list is by no means complete but includes most of the colours of this type usually employed.

Caramel, which is burnt sugar, may be used to give shades of colour varying from straw colour to dark brown.

Cochineal, obtained from the insect *Coccus cacti*, provides scarlet and crimson colours, and may be used in foods.

The colours enumerated, as well as certain selected dyestuffs, may be added to certain foods up to a maximum of 1 part of colour to 3,500 parts of food material. No colouring whatever may be added to meat and meat products, vanilla extract, spirit vinegar or blended vinegar containing spirit vinegar.

There are literally hundreds of coal tar dyes known and manufactured. The water soluble varieties are most readily adaptable

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There are literally hundreds of coal tar dyes known and manufactured. The water soluble varieties are most readily adaptable

by the food industries. In Canada twelve only of these artificial colours are permitted, including five yellow, three red, two blue, and one each of orange and green shades.

These colours must be supplied in specially pure form for food purposes and the amounts used are subject to the same limitations mentioned above.

A declaration on the label of the food container, as to the presence of added colour, is required by the manufacturer except in the following cases: whole milk cheese, ice cream and ices, confectionery (inclusive of jelly powders), butter, flavouring extract of lemon, and smoked fish.

Provided caramel only is used in spirits, vinegar (except spirit vinegar and blends containing spirit vinegar), non-excisable fermented beverages, summer or so-called temperance beverages and sauces, no declaration of colour is required.

Legislation in different countries varies widely with respect to food colours, some authorities permitting a large number of colouring agents. In Canada, while the food colours allowed are less numerous than in some other countries, a sufficient variety is given to produce many shades of colour and at the same time assist in strict laboratory control.—*Press Note, Dominion Department of Agriculture, Canada*

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TESTED RECIPES

The Peach Basket

THIS is the season for peach baskets and for peaches with all the wide variety of tasty dishes made possible by this luscious Canadian fruit. Peaches and cream have long been a favourite dessert, and the Consumer Section, Marketing Service, Dominion Department of Agriculture, offers these suggestions for serving this popular dish.

Select well-ripened peaches. Dip them into boiling water to loosen the skin for easy peeling. To prevent discoloration, drop them into a thin syrup or into a weak brine solution—one teaspoon salt to one quart cold water. Serve well chilled. Brown sugar and peaches are an interesting new flavour combination.

Fruit salads featuring peaches and served with a cream dressing, offer many tempting variations. Peach shortcake, whether made with a plain cake base, or with a hot biscuit mixture, is another favourite for late summer menus. Serve this with a generous amount of whipped cream. Meringue nests filled with peaches have a very festive appearance, and there are many tasty dishes calling for cooked peaches. Recipes for several of these follow.

Peach Meringues

4 egg whites
1 cup fine white sugar
½ teaspoon vanilla

Beat whites until stiff. Add sugar very gradually. Add flavouring. Shape with two spoons or a pastry tube into nests on a cooky sheet covered with brown paper. Bake at 250°F. for 50 to 60 minutes. Fill with sliced peaches and top with whipped cream or ice cream.

Peach Tarts

Put two tablespoons cream filling in the bottom of a tart shell. Place half a peach that has been poached in a thin syrup for ten minutes on top of the filling. Garnish with whipped cream.

Peach Cobbler

2 cups sliced peaches
1 egg, well beaten
⅔ cup brown sugar
2 tablespoons butter
Baking powder biscuit

Mix egg, sugar and peaches. Place in a buttered baking dish and dot with butter. Cover with biscuit dough and bake in hot oven (450° F.).

Peach Tapioca

⅓ cup quick-cooking tapioca
1¼ cups boiling water
⅔ teaspoon salt
3 cups peaches
¾ cup sugar

Put tapioca in double boiler. Add boiling water and salt, and cook until tapioca has absorbed the water. Sprinkle peaches with sugar and add to tapioca. Cook till tapioca is transparent. Serve with sugar and thin cream.

Peach Upside-Down Cake

½ cup boiling water
½ cup shortening
1 cup molasses
2¼ cups flour
1½ teaspoons ground ginger
1 teaspoon soda
½ teaspoon salt
½ teaspoon cinnamon
⅓ cup peaches
Half peaches

Melt shortening in boiling water. Add molasses. Mix flour, ginger, soda, salt and cinnamon together, and sift thoroughly. Gradually beat flour mixture into liquid. Beat until smooth. Peel and halve peaches and arrange in bottom of baking dish. Sprinkle with sugar. Pour gingerbread mixture over peaches. Bake 50 minutes in a moderate oven (350°F.).—*Press Note, Dominion Department of Agriculture, Canada*

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RAM GRADING SERVICE

FOR a number of years breeders of pure-bred sheep have requested the grading of their rams so that the purchaser would buy according to grade. This service is again offered free of charge by the Dominion Department of Agriculture.

The ram grading policy has already done a great deal to eliminate the poor pure-bred. It is still necessary, and in war time particularly, that the general quality of sheep flocks should be maintained on a high level and further improvement effected.

Since a large percentage of rams purchased for breeding purposes in Canada are bought as lambs, breeders will realize the importance of growth and early maturity in order that their stock is well developed and in good condition for the breeding season. It is hoped to have the work done earlier this year in order that the lists of graded rams may be available to prospective buyers as early in the fall as possible.

The Ram Premium Policy has been discontinued. However, in view of the fact that over a period of years rams have been bought on grade by sheep raisers already established, and it is anticipated, as a result of new interest in sheep raising, many other farmers who have the facilities of feed and housing will be buying a flock of sheep and consequently need a pure-bred ram, there will again be a demand for graded rams.—*Press Note, Dominion Department of Agriculture, Canada*

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- $\frac{1}{2}$ cup boiling water
- $\frac{1}{2}$ cup shortening
- 1 cup molasses
- $2\frac{1}{4}$ cups flour
- $1\frac{1}{2}$ teaspoons ground ginger
- 1 teaspoon soda
- $\frac{1}{2}$ teaspoon salt
- $\frac{1}{2}$ teaspoon cinnamon
- $\frac{1}{3}$ cup peaches
- Half peaches

Melt shortening in boiling water. Add molasses. Mix flour, ginger, soda, salt and cinnamon together, and sift thoroughly. Gradually beat flour mixture into liquid. Beat until smooth. Peel and halve peaches and arrange in bottom of baking dish. Sprinkle with sugar. Pour gingerbread mixture over peaches. Bake 50 minutes in a moderate oven (350°F.).—*Press Note, Dominion Department of Agriculture, Canada*

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Diseases of the Pig and its Husbandry

By David J. Anthony, M.R.C.V.S., D.V.S.M. (Vict.) (Bailliere, Tindall and Cox, 1940, pp. xi + 272, 48 illus., 10*s.* 6*d.*)

MR Anthony's book fills a long-felt need for an authoritative book in English dealing with the pig from a veterinary aspect.

Excellent descriptions are given of the various diseases of pigs and in several instances the illustrations of the lesions should enable one to recognize the disease condition as it occurs in the affected animal. Eight chapters are devoted to the description of the diseases. One chapter deals with diseases scheduled in Great Britain, viz. anthrax, foot-and-mouth disease, swine fever and rabies; the next one with non-scheduled constitutional diseases which include the remaining bacterial and virus diseases and protozoan infections; and another with deficiency diseases caused by the lack of minerals and vitamins. Four chapters are taken up by local diseases which include diseases of the digestive, urino-genital, respiratory, circulatory, nervous and cutaneous systems. Dental diseases also find a place amongst these diseases. The last chapter in this series is devoted to diseases caused by ecto- and endo-parasites. Affections resulting from infestation with arthropoda (flies, lice, ticks and mites), trematoda (flukes), cestoda (tape-worms), nematoda (round-warms) and acanthocephala (thorny-headed worms) are all described and a complete list of these parasites and the methods of examining them and their ova for identification are also given. The last chapter of the book deals with mineral and organic poisons, poisonous plants and foodstuffs, which máy cause trouble in pigs, and also contains a description of anaphylactic shock as it occurs in pigs.

Though the description of diseases and their control form the bulk of the book, due prominence is also given to pig husbandry, e.g. chapters are devoted to a description of various breeds, their housing and management, breeding, feeding, dentition and ageing, signs of health, restraint and handling, market requirements, etc. This is all to the good, for it is now clearly realized that in the control of diseases of animals, their husbandry must also be the subject of study and practice.

The field covered by the publication is thus wide and comprehensive. It is attractively printed and bound and contains a vast store of practical information. Here in India, people are beginning to realize the potentialities of this industry, which yields most profitable returns, and we can warmly recommend the book to veterinarians who have to deal with pigs, to pig breeders and to others interested in this industry. [R. L. K.]

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Soilless Culture Simplified

By Alex Laurie, Professor of Floriculture, Ohio State University (McGraw-Hill Book Company, Inc., London, 1940, pp. 202, 12*s.* 6*d.*)

THE idea of 'soilless culture' or the growing of plants with the direct application of nutrient chemicals in media other than the soil conforms itself to the present day mood of the West for shortening everything. Although soilless culture has long been known to the plant physiologists, the movement to commercialize the technique is only of very recent origin. In a country where the pressure on the land is enormous and the climatic conditions adverse to the production of vegetables and flowers all the year round, nothing could be more alluring than the idea of doing away in the urban areas with the usual methods of growing plants in the soil by devising a short cut which would assure a steady and unfailing supply of fresh flowers and table dainties, raised in small receptacles within the four walls of the house, at a cost which is almost negligible.

Unfortunately for the cause of science and commerce wide publicity to such wishful thinking in certain pseudo-scientific quarters has caused much bewilderment to the layman

interested in gardening in a general way. As a result of excessive and premature press propaganda the whole subject of soilless culture has assumed a colour much too bright—like the rainbow effect on a soap bubble. Undoubtedly the technique of soilless culture which still is in its infancy holds out a very bright prospect of developing into an ideal which is now being aimed at by many. Much circumspection is, however, needed in order to save the child from a premature death through excessive zeal displayed by its more ardent followers. When the whole subject has been going rapidly down a precipice the publications on soilless culture within the last year or two by experts like Professors Ellis, Swaney and Laurie have been very useful as brakes by enabling the public to sift the chaff from the wheat of truth.

Prof. Laurie, a well-known expert in this subject, has done a great service to the scientist as well as the layman by writing a book in such a lucid manner. The proper understanding of the factors underlying the technique of soilless culture is what is urgently needed rather than holding out to the public a fantastic vision of untold wealth and gain. Prof. Laurie has helped very much in setting up the proper balance between the scientific and commercial aspects of soilless culture, and has presented to the public solid facts as they are at present known and which could be supported on strictly scientific principles. In short, the *facts* regarding soilless culture have been told frankly, but in a way which is bound to stimulate much thoughtful research on the right lines. The author has very properly treated in detail the scientific aspects of growing plants in a general way. The book can indeed be entitled 'How Plants Grow' rather than 'Soilless Culture'.

Out of a total of 191 pages containing the whole text as many as 103 pages are devoted to the elucidation of the principles of plant nutrition and mechanism of plant growth. The reason for this is explained by the author himself who very appropriately remarks that 'The discussion of plant growth in soil has been made detailed with a specific end in view, viz. to familiarize the reader with the fundamental factors involved. The following discussion of crop grown *without soil* is but an application of these same principles.' This really forms the quintessence of what is popularly regarded as soilless culture. The development of a correct technique can only be possible if the methods employed are based on the fundamental facts so far known to science regarding the dynamics of plant growth. The chapters on the general functions of soils and manures, nutrient deficiency symptoms and the general mechanism of the growth of plants in soils have been written very carefully, and the language being simple and attractive, the subject-matter cannot but appeal to the average layman as well as the student of agriculture.

In the last four chapters the author has given all the relevant information on the subject of soilless culture for the use of the horticulturist and amateur gardener.

In discussing the possibility of growing plants in sand, water and gravel, Prof. Laurie has very clearly brought out two things, viz. facts as they are at present known and the lines on which the technique in each case could be developed as a result of further researches. In the last chapter on soilless gardening for the amateur a complete account has been given of all the methods which could be used with advantage by floriculturists interested in the subject.

Prof. Laurie has already earned fame for himself as a floriculturist and it is, therefore, natural that he should handle the subject of soilless culture with a distinctly floricultural bias. Although the principles would very likely remain the same, it is difficult to foresee at the present moment the extent to which they could be applied to raising ordinary crops, vegetables or fruits. This is a point which can only be cleared up by further research.

Altogether Prof. Laurie's book is bound to be popular as he has with unique success brought the whole science of soilless culture within the bounds of scientific reasoning and sound commonsense. [B. K. M.]

IPECACUANHA

A CORRESPONDENT sends us the following interesting note on the propagation and cultivation of Ipecacuanha:

Ipecacuanha is propagated by seed and by cuttings. Cuttings of (*a*) top growth, (*b*) hard wood, and (*c*) sections of the root are used.

Propagation by seed is perhaps not to be strongly recommended for the reason that to permit this plant to flower and seed, anyhow before it is three years old, is a check on growth, and the percentage of germinable seed cannot be relied on. There is further a doubt if root grown continually from seed will contain a full percentage of alkaloids.

Propagation by top cuttings is the usual way. Take about 4 in. of healthy growth, cut through directly below an eye or heel, cut off intervening leaves, and trim the two top leaves to half.

Hard wood cuttings are taken from below the top cuttings. Take about 3 in. cut below an eye or heel, as before, and trim off all leaves. Hard wood gives the highest percentage of rooted cuttings.

For cuttings from root sections select healthy mature roots and cut into sections about an inch long.

Insert these three classes of cuttings into pure sand, made up on a bed covered with a water-tight roof with the sides protected with matting to exclude light and air. Cuttings should be kept moist and should not be over-watered at any time. When the cuttings have hardened and commenced to root then light may be gradually given. Even with the best of attention a large percentage of failures in Ipecacuanha cuttings must be expected, as this plant is most difficult to propagate and grow.

Cultivation

I have made several trials in India and Burma to grow Ipecacuanha in the open, in raised beds, under the shade of trees, bamboos, etc., but have never been successful. The plant will neither stand the sun nor the heavy monsoon rains of lower Burma and the Darjeeling Himalayas. Very fair results can only be obtained by growing under artificial cover. Long raised beds of 6 ft. width are prepared, in lengths say of 96 ft., and for the purpose of calculation further divided into 8 ft., thus forming—to use the Hindi word—*kamras* 8 ft. by 6 ft. A series of beds of that width are laid out, with 3 ft. pathways and drains at back and front, the beds to run east and west. Over the beds is built a framework of stout posts and bamboo roofs, posts 5 ft. high in front and 2 ft. 6 in. at the back. The roof is thatched with the usual local roofing material, thatch grass in the Darjeeling Himalayas, Nipa leaves in Burma, it matters not what, provided the roof is water-tight. Galvanized iron sheets or timber should be avoided. The soil is raised to a height of 1 ft. in the beds. This is done by using the soil dug up from the pathways and drains and by the addition of leaf soil from the jungle.

As to soil required for Ipecacuanha, in Mergui, the plant is thriving very well in a red lateritic loam, supplemented by a rough leaf soil from the jungle, and to the soil is added a fair amount of coarse sand. Decayed cattle manure may also be added, but this is not absolutely necessary, provided the basic soil is good.

With this artificial method of growing Ipecacuanha it will be obvious that watering and constant aeration of the soil must be given. The plant should be kept always on the moist side but never over-watered. On the other hand the beds should not be allowed to become very dry. The period of maturity required for Ipecacuanha is about three years. The average amount of dried root obtainable in that period is 1 oz. per plant.

Therefore allowing for the 8 ft. by 6 ft. beds for actual planting and the 3 ft. pathways and drains on either side of the beds, we have to deal with an area of 8 ft. by 12 ft. in which at

6 in. apart 192 plants may be grown to maturity. On this calculation approximately 87,000 plants may be grown per acre. This may sound very optimistic and to counteract this I must repeat that the large percentage of failure in growing Ipecacuanha must be taken into account.

The best period to take cuttings of Ipecacuanha is May and June in lower Burma. The cuttings will be rooted and ready to be planted out in October of the same year. The best site for nurseries is an alluvial flat through which is running a perennial water supply.

OLDEST BOVINE IN INDIA

IN October 1924 the Allahabad Agricultural Institute imported a Jersey bull from the Meridale Farms, Meredith, Delaware County, New York. This bull was born on the 4th January, 1924 and was registered by the American Jersey Cattle Club as Passport's Jap, No. 253, 799. He died at Allahabad on the 29th September, 1940 at the age of 16 years, 8 months and 25 days.

Passport's Jap survived four attacks of foot-and-mouth disease during his 15 years and 10½ months in India. He failed to contract the disease on at least two other occasions when it was in the Institute herd. Surviving him are 28 daughters from pure Red Sindhi dams. These daughters average 4,752 lb. of milk each lactation with an average calving interval of 395 days as compared to their Red Sindhi dams with averages of only 1,956 lb. of milk and of 406 days calving interval.

The Institute claims that Passport's Jap was the oldest bovine in India of which there is an accurate record, but we would welcome confirming evidence to the contrary.

MGIPC—M—III-1-134—1-4-41—1,800.

INDIAN FARMING

ISSUED BY
THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

Vol. II : No. 5
MAY 1941

Subscription : Rs. 6 per annum : 8 as. per copy

PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
PRINTED BY THE MANAGER, GOVERNMENT OF INDIA PRESS, CALCUTTA

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CONTENTS

Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Imperial Council of Agricultural Research, Imperial Secretariat, New Delhi.

The subscription is Rs. 6 per annum, 8 as. per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertisements should be made to the Manager of Publications, Civil Lines, Delhi.

Subscribers in Europe and America should apply to the High Commissioner for India, Public Department (Publication Branch), India House, Aldwych, London, W.C.2.

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CENTRAL HERD BOOKS FOR INDIAN DAIRY BREEDS

'IT is vital to the success of these endeavours (distribution of bulls) that adequate records should be kept of the progeny of approved sires, so that a sustained effort may be made to secure that, by due care in subsequent matings, the improved strain may be used to the best purpose for raising the general level of the breed. *The ultimate success of all our efforts towards breed improvement is entirely dependent upon the maintenance of sufficient and accurate records.* Without such recording of pedigree and performance, the impulse will wane, and such improvement as may already have been obtained will be irretrievably lost in the vast aggregate of India's cattle population.'

These words of His Excellency the Viceroy at the first meeting of the All-India Cattle Show Society are based upon the universally recognized fact that registration and recording constitute the corner-stone on which a successful cattle-breeding industry must be built up. If one examines the history of man's exploitation of livestock and the evolution of high-grade cattle in advanced livestock countries of the world, it will be found that progress in the cattle-breeding industry was halting and slow till about the middle of the nineteenth century, when the modern type of Herd Book began to appear. Once this appeared and its value was recognized, it grew in popularity and development was rapid, both in the cattle-breeding industry and in the movement for registration and recording. These have acted and reacted on each other, and it is clear that the pace of cattle improvement has been quickest in those countries in which pedigree registration and milk recording have made the most rapid strides.

The Imperial Council of Agricultural Research long since realized the value of pedigree registration and milk recording, and in one form or another the subject has found a place on the agenda of almost every meeting organized by the Council. Various steps have also been taken to popularize and promote registration and recording. The several studies of milk production data, publication of milk records, introduction of uniformity in recording by the free distribution of standard forms, the periodical checking of milk records, the financing of schemes for the establishment of milk recording units in breeding areas in the villages, the publication of definitions of recognized breeds and the descriptions with photographs of other important types are some of the steps taken in this direction.

Early in 1936 it was decided by the Council that Central Herd Books should be established at New Delhi and maintained by the Animal Husbandry Bureau of the Council in respect of milch breeds of all-India importance. The essential preliminary step in the establishment of Herd Books is an authoritative definition of the characteristics of the breeds chosen for registration and those to which attention was primarily directed were Gir, Kankrej, Ongole, Sahiwal, Red Sindhi and Hariana cattle and Murrah buffaloes. For this purpose conveners were appointed, meetings of breeders were arranged in the home of these breeds, and in consultation with them the conveners drew up a schedule of points in respect of each breed. These were scrutinized by an

appropriate committee and published by the Council in 1938 as Miscellaneous Bulletin No. 27. The next step was the preparation of rules and regulations for the maintenance and operation of Herd Books, which were drawn up with a covering note explaining the scope of the Herd Books, the procedure to be followed in applying for registration and the local organization necessary for the work. These proposals, with the comments of the provincial Governments thereon, were placed before the Advisory Board of the Council in November 1940 and were approved by them, so that it may be said that Central Herd Books for Indian cattle have now been established.

The necessary forms are being printed, and as soon as these are received from the press the Council will be in a position to entertain applications in respect of the Sahiwal, Sindhi and Hariana breeds of cattle and the Murrah breed of buffaloes, to which it is proposed to restrict the scheme for the present. Provincial Governments have been informed accordingly and requested to register with the Council in the meanwhile the system of marking in vogue in their respective areas and farms. According to the Herd Book rules no application can be entertained unless the systems of marking adopted by breeders have been previously registered.

Briefly stated, any person who owns or breeds stock of any of the four breeds mentioned can apply for registration in respect of animals which conform to the definitions laid down in Miscellaneous Bulletin No. 27 and which satisfy the minimum milk yield qualifications prescribed in the rules. These milk yield qualifications are: 3,000 lb. for Sahiwal, 2,500 lb. for Sindhi, 2,000 lb. for Hariana cattle and 3,000 lb. for Murrah buffaloes in a lactation not exceeding 300 days in length.

Any bona-fide owner or breeder interested in this work will, on application being made to the Secretary, Imperial Council of Agricultural Research, New Delhi, be supplied free with a copy of the Rules and Regulations and the explanatory note mentioned above. It is hoped that breeders will avail themselves of the opportunity given to enhance the value of their cattle. It may be added that the service is absolutely free and that no fee will be charged for registration of pedigrees, performance, births or transfers, but it is essential that accurate records should be maintained for which suitable forms will also be supplied free.

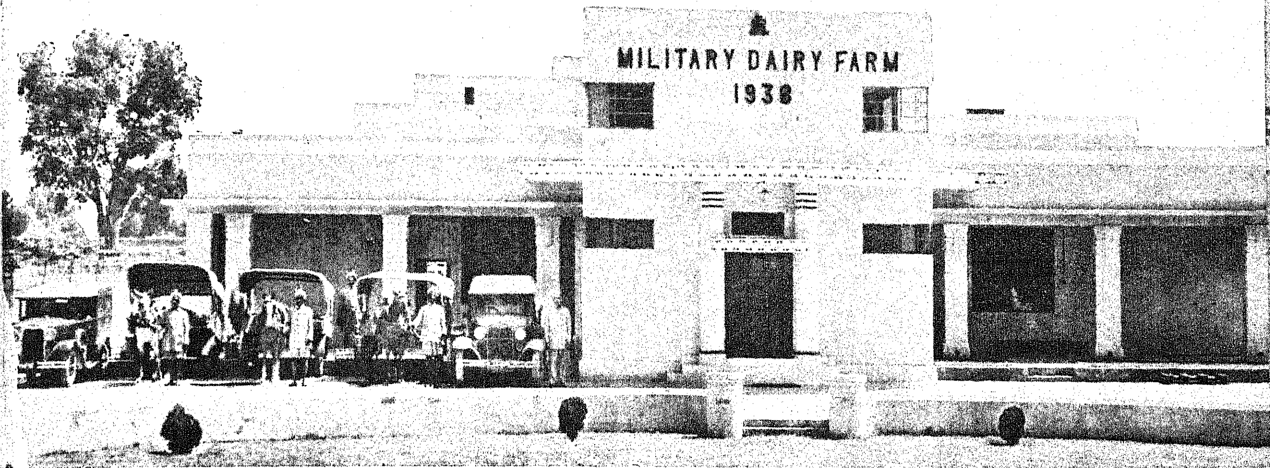
M. ALAM

M.Sc., F.L.S.

WE record with regret the passing away of Mr M. Alam, Economic Botanist and Rice Specialist, Bihar, on 26 February 1941.

Mr Alam was born on 5 August 1901. He took his M.Sc. degree in Botany from the University of Lucknow and thereafter did his postgraduate training under the late Dr F. J. F. Shaw, Imperial Economic Botanist at the Imperial Agricultural Research Institute. He was first appointed as Assistant Economic Botanist, Bihar, in January 1929, and was promoted to the post of Economic Botanist from 1 April 1935. He was in charge of the Rice Research Station of the Imperial Council of Agricultural Research in Bihar from the inception of the scheme in 1932, and in this capacity did very valuable work.

A VISIT TO A MILITARY DAIRY FARM

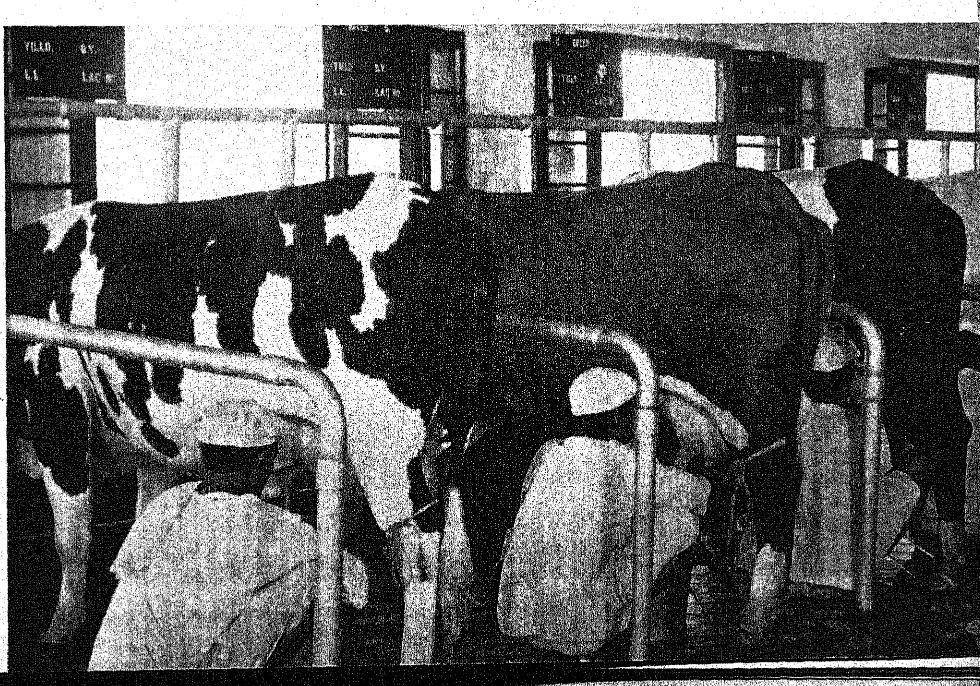


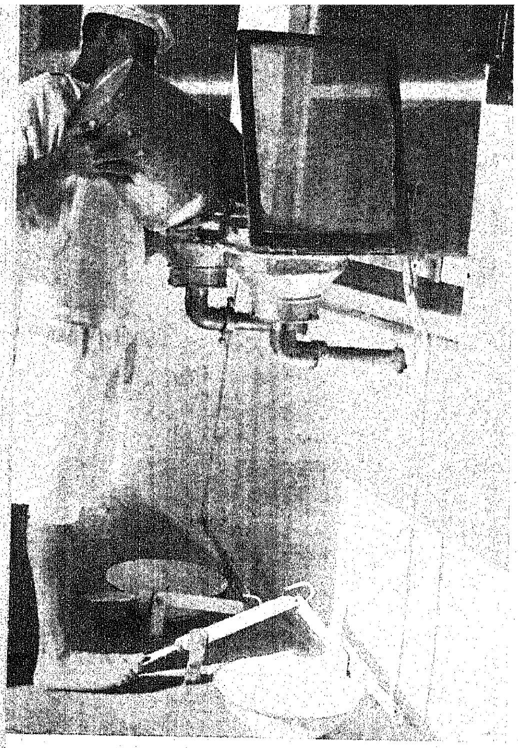
Top: The building should give the necessary impression of cleanliness and efficiency. Note the smart deliverymen, good vehicles and well-fed delivery animals. It is advisable to place the dairy building at the entrance to the farm so that it is the first building to be seen by customers.

Left: The *gowallas* lined up before milking. Note the inspection of hands and milking pails. Good *gowallas* with clean habits, clean clothes, clean hands, clean milking pails—milking clean, healthy cows in clean surroundings.

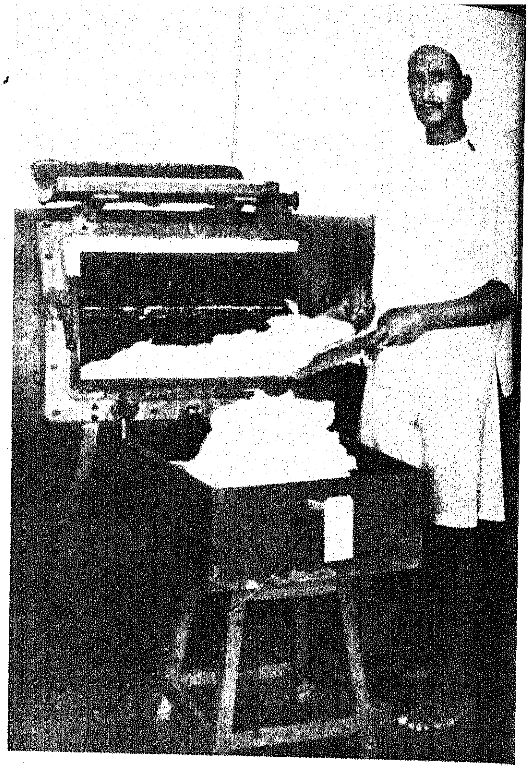
[PLATE 6

Right: Cows being milked. Note the type of stanchions used—simple yet effective. The cows are tied by means of a chain fixed to rings which slide up and down the upright pipes. Comfortable and inexpensive. The cows must be groomed at least 30 minutes before milking starts, and before the *gowallas* put on their milking suits. All manure must be removed from the shed. Good sheds are of little help unless the inside is kept clean.

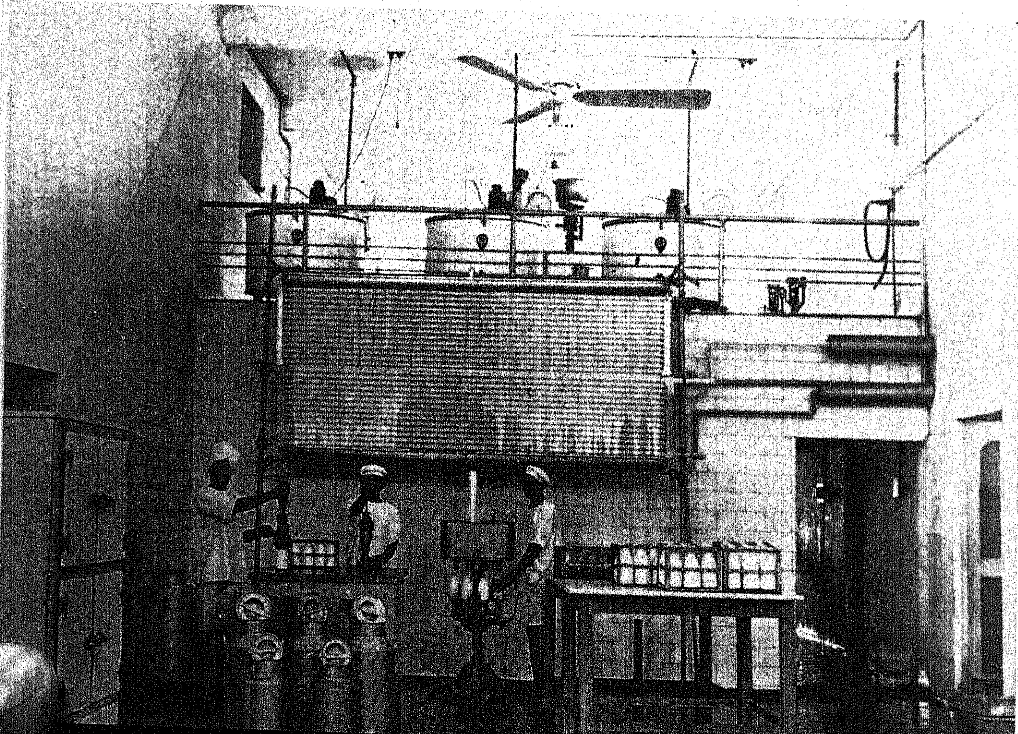




Milk being poured into the milk room. Note the method by which the gauze lid over the funnel is lifted by means of the foot, leaving the hand free. An overhead fan (not seen in the photograph) keeps the flies away.

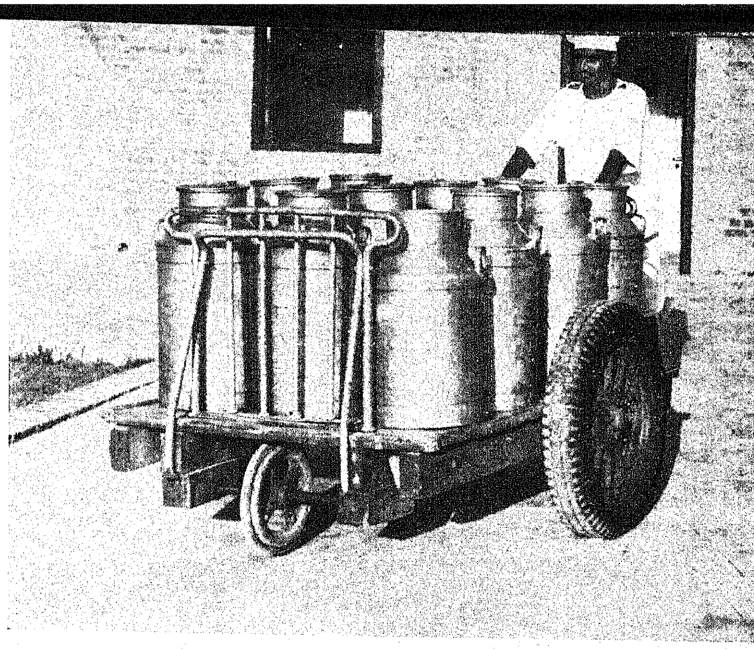


Manufacture of high-grade butter. When the day temperature is over 80° F. it is difficult to manufacture a high-grade butter unless a churn with an internal worker is used. This type of churn exposes the butter to the air for the shortest possible time before being placed in the cold store.



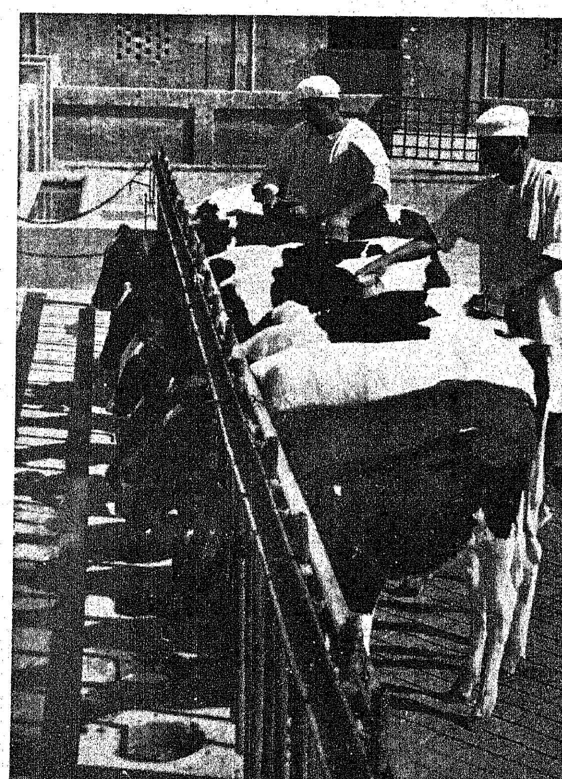
Left : The interior of the dairy. There must be plenty of light and air. Note the tiled walls, the clean uniforms of the workers, and the small refrigerator for window sales. The capacity of the plant is 5000 lb. of milk and 2000 lb. of butter and 100 lb. of cheddar cheese daily. The interior should be planned for maximum efficiency in the processing of milk hygienically.

Teaching the calf to drink. The finger is placed in the mouth and then the hand is gradually lowered into the bucket. The calf will soon begin to suck up the milk. The future of the herd depends upon the care and attention given to the calf. The calf should be weaned at birth in order to know how much milk the dam produces.

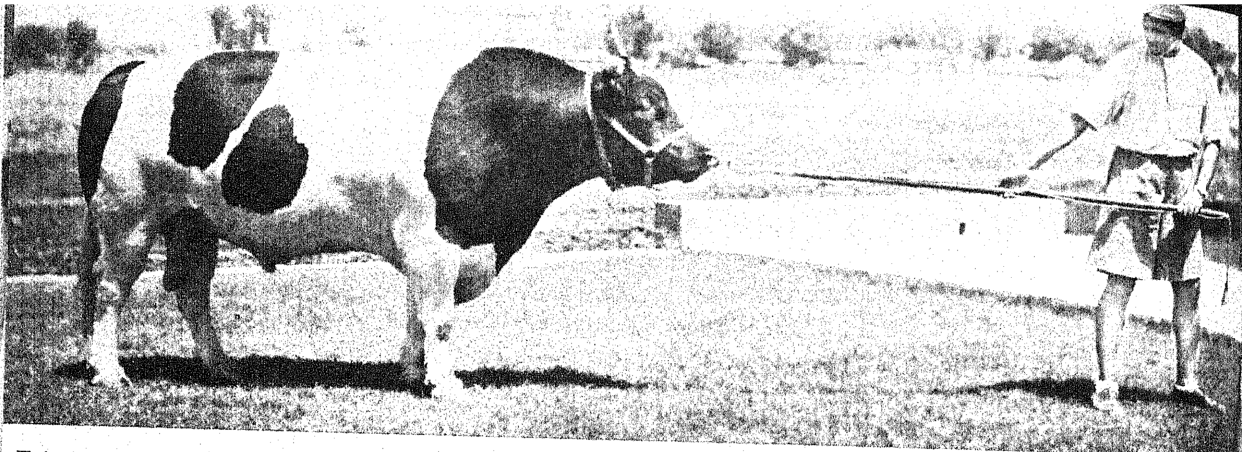


The milk on the way to the dairy. Note the type of trolley used. This trolley can carry about 1,000 lb. of milk.

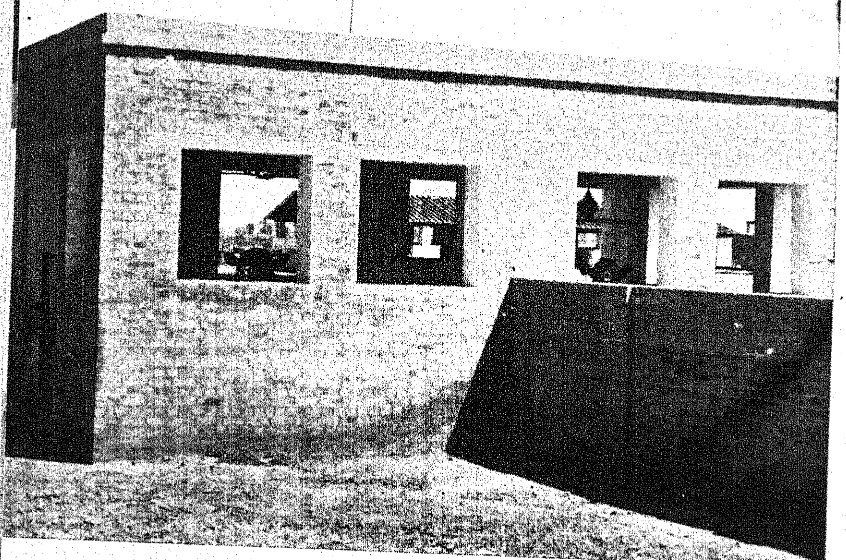
Below: The calf should be dehorned when seven days old. The sacking and straw placed below the calf prevents it from being injured if it struggles. The name and number of the calf should be tattooed in the ears at the same time.



Right: It is not sufficient to feed calves properly: to keep them healthy they must be thoroughly groomed twice a day. The grooming is of great importance during the hot weather as it enables the calf to utilize its skin fully in throwing off heat.

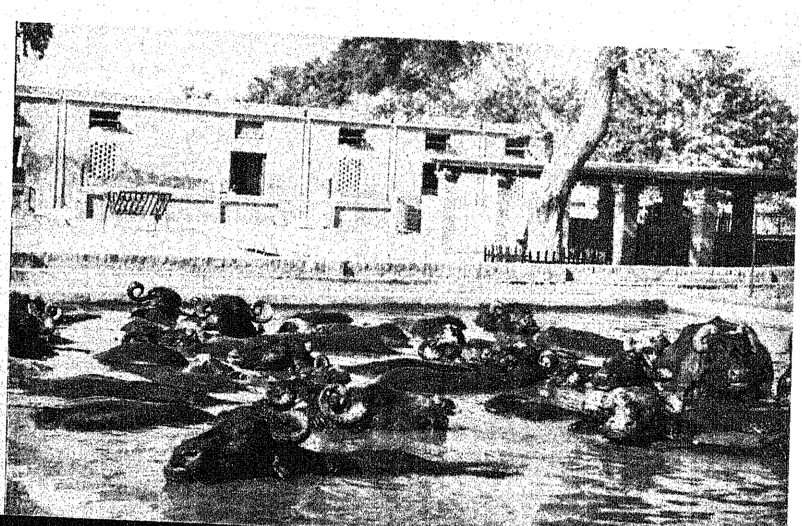


. Friesian bull. He looks quiet but is not to be trusted. As a rule, if he is an indigenous animal, he is not vicious, but he should be treated with respect. If he is an imported animal, he should not be handled without a bull lead.



Left : The bull should be given a separate paddock into which cows to be served can be placed. The bull house should be airy, yet give full protection from the sun, wind and rain. If the bull is of a foreign breed it may require special attention during the hot weather, and a foot of damp sand in the bull house with a fan overhead and, if necessary, a *khas tatti* on the windward side will keep him quite happy through the worst days.

Right : Keeping the buffallo contented during the hot weather. Providing wallows is money well invested as it will soon be repaid in increased yields of milk. The wallow must be above ground-level so that they can be emptied and cleaned at least twice a week. A wallow 30 ft. × 30 ft. × 3½ ft. will hold 50 buffaloes. Note the contended look on the faces of these buffaloes.



Original Articles

THE DEVELOPMENT OF THE CANNING INDUSTRY IN INDIA

By Luis Jose de Souza, M.A., M.Sc.
Food Technologist, Corn Products Co. (India) Ltd., Bombay

To say that the canning industry—using the term in its widest sense to cover all sides of the preserving industry—is an indispensable ally of the agriculturist, and the horticulturist in particular, is to state a truism. And it is, therefore, all the more surprising that in India, an essentially agricultural country, this important industry should not have received till now its due share of attention on the part of the industrialist and the capitalist.

Interest in India

It is, however, heartening to note of late a great deal of interest in this direction all over India. Some provincial Governments have already directed their attention to the subject. And the Imperial Council of Agricultural Research is also moving in the matter and is planning a central research station to help the development of the industry in the country.

This is all to the good. But if it is an admitted fact that Government aid is necessary, even imperative, in the initial stages, the initiative must come from the industrialist and the capitalist. Of course, by initiative is meant a lead in the establishment of the industry and not in research, which last is more properly the field of the Government. The statement is not superfluous, for to the writer's knowledge, there were at least two attempts by a provincial Government to establish small canning plants with a view not necessarily to compete with private enterprise, which did not exist, but obviously with a view to encouraging the establishment of similar enterprise. The fact that both the plants were subsequently turned over to private enterprise bears out the statement.

The fact that a start has been made in Madras, Bombay, the Punjab and the United Provinces is a proof that the huge possibilities of the canning industry are being realized. The home market for preserved food is big enough to absorb the output of a dozen large canneries. For India imports canned food of the value of over two crores of rupees annually. And there is a potential foreign market which is not to be despised. It may be explained here that by preserved foods is meant not only fruit and vegetable products, but fish, meat, and a variety of farinaceous foods, not to mention condensed milk and allied products.

Finance

The market for the products being thus almost guaranteed, the next step is the financing of the industry. As in every other industry, this is a point of vital importance. Fruit being a seasonal product the need for adequate finance during the packing season is patent. But it is not only for working the factory that abundant liquid capital is needed. The distribution and advertising needs of the industry are great, and both demand heavy outlay.

Canned foods are not a popular item in the Indian menu. But signs are not lacking that they are steadily growing in popularity. There is nevertheless a lot of groundwork to be done further to popularize canned and preserved foodstuffs. Obsolete notions about the nutritive value of canned foods have to be dethroned. The exaggerated ideas about food poisoning have to be corrected. The consumer has to be familiarized with the science and scruple that go into the manufacture of a canned product. And last but not least, the public must be educated to give the *swadeshi* product the credit of being able to stand comparison with similar products of foreign manufacture.

This brings us to the third need of the industry, technical assistance. Canning today is no longer a hit-or-miss proposition. It has developed into a science and an art. The Food Technologist, one who deserves the name, is a combination of chemist, bacteriologist and engineer. It is, therefore, of the utmost importance that proper technical help should be secured before starting a cannery.

Quality essential

The prejudice against Indian products may be traced to a great extent to the carelessness with which they are preserved and packaged. The need for securing the best available technical assistance cannot therefore be overemphasized. It is not cheapness alone that will go to popularize canned foods manufactured in the country, but the quality of the products offered to the consuming public, and the form in which they are presented.

So far the requisites of the industry. But there are what one might call certain prerequisites the existence of which is necessary to assure the enterprise a steady development. First and foremost comes the problem of containers, whether tin or glass. At present we are almost entirely dependent on imported containers, and these are heavily taxed at the Customs. If the Government really desire the establishment and development of the canning industry in India, facilities in this direction must be provided. Until such time as the development of the industry justifies the establishment of a large-scale can-making industry—by itself a highly specialized industry—the Government may at least grant a rebate of the duty paid on the containers imported and used by the canneries.

The next in order of importance is the granting of lower tariffs for the transport, by rail, of raw materials to the canneries, and for distributing the finished products of the canneries. The railway tariffs are at present extraordinarily high, and a reclassification is urgently needed.

The third step is to make available to the canneries sugar at cheaper rates than those at present obtaining. This is a subject which well deserves to be dealt with by itself. But suffice it to say that unless the sugar manufacturers and the Government grant some facilities in this connection the progress of canning in India will be a difficult one, if not a problematic one. As a first step the Government can give a rebate on the excise duty on sugar used by the canneries. This can be partial for products sold in the country, and total for those exported out of British India.

It will come as a surprise to many that under the guise of jams and jellies alone about 14 lakhs of pounds of sugar comes into the country, and naturally without paying the heavy excise duty. It is true that these products pay a 25 per cent *ad valorem* Customs duty. But so do canned green peas which contain no added sugar at all. Our exports to foreign countries are taxed according to their sugar content. Could not such a measure be devised for similar imported products also ?

A potential ally

Parenthetically, is it not high time that the Sugar Syndicate, now casting about for an outlet for the surplus production of the industry, realized that the sugar industry has a potential ally in the canning industry ? In addition to jams and jellies mentioned above India imports large quantities of fruits in syrup, fruit squashes and syrups, condensed milk and other products all of which contain considerable quantities of sugar. Will the Syndicate turn its attention to an outlet nearer home ? The increase of duty on imported sugar may serve to guarantee the present high prices of sugar. But in the author's opinion the development of the market offered by the canning industry would be of a more lasting benefit to the sugar industry.

To return to the subject : The establishment and development of preserving and canning of fruits and vegetables in India demands a combined effort on the part of the Government, the industrialist, the capitalist and the fruit-grower. The greatest need of the fruit-grower is marketing facilities for his produce, and in this the canning industry can certainly help him immensely. But there must be cooperation between the canner and the grower, without which neither the one nor the other can secure adequate returns for his labour. The point to be kept in mind is

that the canner is an indispensable ally of the grower, and therefore must be treated as such.

The cooperation between the grower and the canner may take some or all of the following forms: proper picking, grading and transporting of the fruit from the field to the factory; the fixing of prices which should be compensating to the grower and economic to the manufacturer; lending of technical and more particularly financial help, wherever possible, by the canner to the grower, and *vice versa*, the granting of credit facilities by the grower to the canner; and last but not least, the grower holding a financial interest in the cannery.

Cottage industry

So far we have dealt with canning on a large scale. But small-scale effort, too, has a definite place in national economics. The preserving industry can and should be developed on a cottage-industry scale also. In the United States of America this is done on a cooperative basis in what are known as 'community canning centres'. Under this system small but fairly complete canning plants are set up in certain centres under the direction of a trained demonstrator. The growers, members of the organization, bring their produce to the plant and have it canned under the expert assistance of the demonstrator who regulates the standard of the pack. Something on these lines can easily be done in India if the agricultural demonstration centres are also turned into canning centres.

To create a bias in favour of fruit preservation, and more particularly in the bottling of fruit juices, it will be necessary to organize popular lecture courses and training and demonstration centres. In the beginning the Government demonstrator can move from place to place giving demonstrations and supplying information to those who may be interested in taking up the industry. A word of caution may not be out of place here. Those who may be interested in starting fruit preserving on a cottage-industry scale must not forget that it is absolutely necessary that the products thus manufactured must conform to a certain standard. For otherwise the enterprise will be heading towards disaster. If the manufacturing side needs great care and knowledge, the selling side is even more difficult and exacting. It will pay the small manufacturer to work in cooperation, wherever possible, with the large-scale manufacturer.

The establishment of the canning industry in India is, therefore, not only possible and desirable, but is vitally necessary and urgent. To tax the imported fruit is by no means the only or even the best way of helping the fruit-grower. By making fruit dearer one cannot increase its consumption. The urgent need of the grower is organized marketing. And nothing can aid the grower in distributing his produce better than the preserving of the fruit, which means canning.

The scope of the preserving industry must not be limited to the canning of fruits and vegetables. The canning of fish and meat products offers as large a field as the canning of fruit. Poultry-farming can certainly be given a powerful impetus by the aid of canning. Chicken essence, chicken soup and chicken meats in different forms are popular products. And poultry-farming can be made a paying side-occupation for the farmer. We import canned fish of the value of over 16 lakhs of rupees annually. And with the unlimited possibilities of our fisheries there is no reason why fish-canning should not be a paying proposition. The writer has canned fish under various forms, and can state that the market, the internal market alone, for canned fish is excellent.

It is therefore to be hoped that in the not very distant future the canning industry in India may grow into an industry of the first magnitude as it is in Europe and America. India offers conditions for the rapid development of the industry. There are hurdles to be overcome and hindrances to be removed. But given the goodwill of the Government, signs of which are not lacking, and the necessary private initiative, nothing can prevent the hope from becoming a reality.

CATTLE-KEEPING AS THE CENTRE OF THE FARM-ORGANISM*

Condensed and translated by G. T. WRENCH, M.D.

THE beautiful Mark, with its lakes, woods and heaths, has mostly been an area of trouble for the peasants. Considerable districts, which in the Stone Age served for cultivation and fisheries, are now scarcely worth cultivating. With its sandy soil, it cannot compete with other areas and respond to intensive treatment. Only a few farmers try to use it. To this land, the farm of Marienhohe belongs. On the north-west of a large lake lie some partly wooded heights and on a rounded unprotected upland lies Marienhohe, situated about 100 miles to the south of the Baltic Sea. The surrounding woods have for long been pine trees which are unsuitable to keep the balance between the dry uplands and the hollows with their lakes and ponds. The sub-soil of the upland is sandy gravel, so that sub-soil water plays a very small part. The rainfall is slight, from 13 to 17 in. yearly. Over the large lake, the rainfall is 30 per cent greater. The rainfall only just suffices, the pine woods do not modify the dry atmosphere, and Marienhohe, being open on all sides, is freely exposed to the drying effect of the winds. Small bits of humus become powdered to dust, and are blown away in gales. The blown sand clogs the plants and does special harm to fine-leaved plants such as clover, serradella and buck-wheat. It scours the young shoots away. The ploughed land crusts readily owing to the quickness of drying after the rain.

Marienhohe was used for sheep at the beginning of this century. It then became the property of a bank, and passed from one farmer to another. After the war of 1914-18, a company took it over without any fortunate results, and finally on 1 January 1928, Dr Erhard Bartsch took the farm.

*An article by Dr N. Remer, Diplomaed Agriculturist, in *Demeter*, October 1936.

A Mark country farm

With 60 hectares, (150 acres) of arable land and 15 of acid grassland upon a 70 per cent sand and gravel soil, the estate seemed poor enough and the pine woods were not much compensation.

The first need, especially for cattle, was to establish sufficient pasture land. Much of the low land near Marienhohe is marshy and needs drainage. The rest gives a moderate yield of acid hay.

Had the new owner been fitted out in the same way as the old, there would have been no chance of Marienhohe affording a permanent living. *In spite of this, it was decided to make it a self-contained farm.* The permanent addition of dung, fodder, seeds and beasts from all parts of Germany would not have been able to bring about this desired result. What was done was the application, for the first time, of bio-dynamic methods to this part of the German east land. A pre-requisite of a self-contained farm was to shut out the supply of dung and fodder from without.

Lever to restoration of fields

As soon as possible, the few sickly animals bought with the land had to be made sound and more numerous. Both plants and non-indigenous animals had to be fitted to the sandy soil. Beasts kept in one soil locality order the living conditions of their lives to that soil. Only when cattle bind their whole nature with the soil that nourishes them can they and the soil unitedly reach their full strength.

To reach this goal on this poor farm was difficult. The type of feeding and the whole rotation of the fields had to be changed. A tractor was brought into full use but got rid of as it was too hard for the light soil. Five horses and two oxen did the work.

The land, which had constantly been burnt

through, required mixed cultivation as carried out by the bio-dynamic methods.* The poor land had to be given an even covering of plants. Legumes, improved bio-dynamically, make many mass areas grow oats again.

Growing fodder

The following is the plan for providing fodder and straw :

90 acres (*morgen*)—1. Potatoes, grown with stall dung. 2. Oats—lupines or vetch or summer oats or summer rye—summer barley with clover. 3. Rye with serradella.

15 acres—1. Lupines up to seeding. 2. Rye grown with stall dung and followed by lupines allowed to seed. 3. Oats.

36 acres—1. Serradella with lupines up to seeding. 2. Rye with stall dung, then lupines for cutting. 3. A summer cereal.

50 acres—1. Turnips with cowdung. 2. Summer barley with clover. 3. Clover. 4. Rye or spelt with lupines for cutting. 5. Oats.

50 acres with lucerne, a summer cereal, maize, sunflower, rape, and, in future, turnips in rotation.

The cereals are important because of their straw-fodder. They were distributed with legumes and green fodder as follows :

6 acres with rye and pannonica, 9 with rye, clover and vetch, 10 with clover and green fodder, 4 with lucerne, 10 vetch, buck-wheat and other green fodder, and 10 acres with turnips and carrots for winter fodder.

Near by the farm was an unfruitful upland, where the young animals pastured, and built up their ability for a good utilization of the fodder. There were unpretending grasses, such as knotgrass and couch grass, on the gravel soil.

The potato is a humus devourer, and, as there was not at first much humus, the potato was discarded but later begun again when there was more humus. The grain crops produced mixed straw for cattle feed. There was also hay and green fodder. Clover was cut twice, lucerne three times.

Food plan

Beginning of May to end of July—Rye fodder. First cut of clover and lucerne, second cut of clover and lucerne.

July, August, September and October—In the fields, serradella, clover, lucerne, meadow grasses, sunflower.

November—Sunflower, mixed straw, turnip leaves.

December to April—Turnips, straw, hay.

The legumes formed the ground stock for the rebuilding of the cattle herds. The bought herd of 13 became 23 milking cows and many young. This was only made possible by the greatly increased nitrogen in the soil. With the better fodder crops, better corn crops followed, although occasional droughts brought all growth to a standstill. Peas, lentils, clover and lucerne became a part of the land, which had not previously known them.

The success was not in any way due to lime. From taking over in 1928, none was used. The acidity of the soil was overcome by legumes, a little prepared stable manure and above all by intensive bio-dynamic manuring which is compost assisted by auxin preparations.

The laying down of clover has been the more valuable, as thereby much more ground can be used for turning the cattle out to grass in the autumn. Otherwise there was only the stubble of the serradella at disposal.

* These bio-dynamic methods become clearer as this paper proceeds. They are the establishment on the farm of the same balance of plants, animals, birds, and insects as occurs in the everlasting recurrence of the forest and jungle in nature. This establishment is brought about deliberately by the knowledge of man of the natural conditions of the land which he is farming. Such local knowledge is essential to him. Much of it, but by no means all, exists in the traditional practices of the peasants. Knowledge adds to and strengthens these traditions. Bio-dynamic methods also include careful composting, helped by certain injections of special rotted vegetable matter, which are believed to contain auxins or what in biology are called hormones. Some early growing crops are sometimes sprayed with a solution of these vegetable hormones.

To keep the herd healthy, going out on to the pasture lands, even though only for two to three months, was essential. Also for health, they were occasionally driven out in the winter. Such measures were particularly necessary, as, on taking over, the herd suffered from contagious abortion and were strongly tubercular. In 1928, a number of beasts had to be destroyed owing to tuberculosis, indeed it was debated whether it would not be better to destroy the whole herd to get rid of tuberculosis as well as contagious abortion and other diseases once and for all. That would have meant purchasing a new herd. As, however, the fine results of bio-dynamic methods in restoring health were known, the herd was not sold, but taken over to receive the healing methods of fresh and varied foods from the same soil. A marked success followed rapidly. The previous 70 per cent unfruitful herd suddenly recovered, welcomed the bull and produced calves regularly. Without the complete re-planning of feeding, such success could not have happened.

Here the new planning of the farm proved of surprising value. The immediate intense bio-dynamic handling of the fodder fields and the setting up of a sound food-plan of their products became the basic measures for the logical resetting of the estate.

What the health of the herd signifies will be clear to every manager of a farm, especially such as, year after year, are threatened by animal sickness, and yet more perhaps, if he has experienced the stall-manure effect upon the condition of health throughout years for comparison.

Development of the herd's fertility

By 1936, of 23 cows, 21 had been born and brought up on the estate. At taking over, the 13 cows were all bought. They were discarded one by one. There were in 1932, 22 cows and 23 calves, in 1933 the figures were 18 : 17, in 1934, 17 : 16, in 1935, 23:22. The line of health, which continuously developed in the herd, showed itself in all directions.

To ensure better fodder crops, the land had to be protected against the damaging wind. This was brought about by planting special hedges and trees. The slopes of the garden were terraced for the finer fodder stuffs and protected by hedges of plants that could withstand the conditions. These garden hedge plants were then able to be transplanted to protect the fields. The whole land picture thus became altered. Everywhere the visitor sees fine and blooming shrubs and young trees, and a new plant and animal world upon the land. In the shelters of the hedges, birds nest, the hedgehog hides, hens and hares find protection, a lively world of insects lives. So much life comes upon this small part of the earth again. In free instinct each animal seeks the enhancement of the particular food that ensures its health.

Increase in milk production

The milk production of the herd surpassed anything to be expected in this Oder area with its poor soil and climate. The average supply on the peasant farms is 333 gallons (1,500 litres) in a year. It is true that at Marienhohe, before its reconstitution, the milk was notably more, but this was only reached by the regular importation of new cows from specially bred herds and by the importation of special foodstuffs.

Average milk yield per cow

Year	Number of cows	Average yield
Before reconstitution—		
1926-27 . . .	10	2,450 kg.
1927-28 . . .	11	3,240 kg.
1928-29 . . .	10	2,730 kg.
After—		
1932-33 . . .	20	3,260 kg.
1933-34 . . .	16	3,310 kg.
1934-35 . . .	13	3,350 kg.
1935-36 . . .	14	3,500 kg.

(Kg. is a kilogram or $2\frac{1}{5}$ lb.)

The young cows born on the farm showed:

Year	Bella	Drudi	Dora	Erika	Flotte
1932 .	3,700	2,885	2,894	1,783	—
1933 .	4,125	2,960	3,079	2,772	2,450
1934 .	4,992	3,434	3,850	3,000	3,171
1935 .	5,150	3,478	4,320	3,902	3,519

Here attention is drawn to the staff. That was skilled, trained and devoted. The owner had had wide experience, the chief milker had trained at Allgau. Without sound understanding the bio-dynamic methods cannot earn their real success. They require much more thinking than the usual routine of a farm.

The use of fodder

The chief fodder consisted of raw food, poor in protein, such as sunflower, maize, straw, hay from acid meadows, turnip leaves, with roots of turnip and beet-turnip as soon as the outside life of the summer weather came to an end. Even during the outside life in autumn when the animals fed on serradella and the meadows, straw and sunflower had to be given also. The good provision of this herd on its poor earth can only be interpreted by the high quality of the fodder. The turnips are firm and last long. The beautiful gold fodder-straw is spread by the milkers of the animal in the mangers. In other farms, the straw, when it stood as corn in the nymph state, was already darkening. The golden colour of the stems disappeared quickly, the straw became brittle and dusty in the stalls, where it was mostly taken unwillingly by the beasts. Ours was softer and weaker, which qualities the beasts notice also very readily in green fodder. The result was not brought about by coarse dunging or other such means. The labourers effected it with 'predigested' (composted) dung and fine material for the strength of the soil and plants, through which the ancient strength of the earth revived and imparted itself to the beasts. So the homeland became a true home to the domestic beasts.

The animals received a little so-called 'force-food' (mixed oil-cake) ½ kg. (1 lb.) average daily through the year. Some of this consisted of our own rape-cakes, a like amount was of Demeter-clover. Forty to seventy swine also received the estate food.

The best by-product as an extra food for milk-cows is the chaff of spelt.

It is always a cause of wonder how the right actions work out in their varied way within one organism. If a farm is built up upon an insight into the natural dynamic happenings and living associations of various natural cycles, there is built up, from within out, a powerful unity.

This Marienhohe taught us in the progressive building up of rape and spelt. Rape with its oil and meat benefits backward cattle. Spelt permits the farmer to use soil that is unsafe for wheat which sucks out the land. It provides a food equal to clover. So health streams to the animals, which they repay with a rich supply of milk. When the cow Wasp, the true parent of our herd, rendered 4,500 litres and more and her daughter Bella was equalling and surpassing her, this abundant milk was *not due to feeding great and protein-rich masses of fodder, but to the varied and general goodness of the foods.*

Because of this good feeding, the quality of the milk found high favour with the people and institutes of the neighbouring health resort. More milk and more health went together with our cows. Fertility was very high, over 80 per cent being a rarity in herds. Very notable was the health of the rising generation of animals.

From the notorious calf-illnesses, such as diarrhœa and inflammation of the lungs, after the reconstitution we had no experience at all. After birth the calves at once spring up and from that time on show such temperament and the lust of life that it is a shame that any have to be killed. The weights of seven calves are given—(1) 389 lb. on the 124th day, (2) 380 lb. on the 120th day, (3) 1,023 lb. on the 455th day, (4) 420 lb. on the 162nd day, (5) 1,177 lb. on the 600th day, (6) 1,049 lb. on the 573rd day, and (7) 550 lb. on the 218th day.

The calves are readily bought by neighbouring farms. A number of characteristics, vitality, health, and liveliness are remarked by everyone who sees them. They surpass other calves in their new homes.

The miracle

Many letters are received, some of which record the general high appreciation of the milk, others praise the good growth, the strong bones, the beautiful coats and

the other signs of lively health of the calves. In spite of the poverty of the soil, it has been able to render these gifts.

The facts stand before us like a miracle. Out of this sandy floor has come a fount of animal health. The one-time sick herd has acquired a second health. Such sick herds usually need food from without and the addition of sound male and female beasts from outside, to keep them in business. Previously the methods in no way revealed the facts of the benefits and good qualities which really lay in the structure of the plants of this sandy soil. On Marienhohe probably for the first time, owing to Rudolf Steiner's well-known insight into nature, even here these qualities have been transferred to the animal world by means of hard and sacrificing work.

The young plants take upon themselves a new and lasting constitutional capacity. They reproduce abundantly. On the farm, with its variety of soil character, the seeds, after experience, took more readily to the sandy soil. That this same influence of the earth occurred in the animal world was unknown to us. Scientific theory asserts that sand soils are too lacking in acid calcium phosphate to serve animal breeding. This may well be so in the case of those business farms where the unity of animal, plant and soil is not realized. We fortunately have been able to build up this unity out of the coarse and fine workings of nature in spite of the disadvantages of the climate and soil of Marienhohe, and especially in spite of the first four dry years of the new farm's existence, with its, at that time, poor supply of straw and the resulting stall dung. All the more astonishing is that without any assistance from outside, without any chalk laid upon the fields and meadows, we got cattle with such notable strength of bone. It was surprising to find that there was existing in gravel itself an ideal and practical innate value-quality.

We face the phenomenon of a powerful bone structure, which has arisen from a chalk-poor soil. When Dr Bartsch took over the farm the fields showed acidity and lack of chalk. Some few hundredweight of mineral chalk yearly was made use of, mostly for the garden, with a view to the preparation of compost. Also some Weleda chalk-fodder was used, which, though it has a low chalk content, is useful owing to its quality.

Bone building

The development of the Marienhohe herd gives the impression that, as regards chalk metabolism in bone building, the gravel is not without its part and that it unites itself with the physiological events which bring into being the well-marrowed bones. As carriers of marrow the bones constitute an important animal organ. The blood is there constantly renewed. From here, then, issues a good part of the whole animal health.

The plants, preferably developing on the gravel soil, frequently show a notable chalk content; such is the case with lupines, sunflower, and serradella.

It must be clearly understood, however, that the animals did not live exclusively on chalk-rich plants. On the contrary, most of their food was poor in chalk, hay from acid meadows, straw, chaff, turnip root and leaves, maize, green rye. Certainly every effort was made to get fodder that would build up the animals with a due supply of chalk, by the cultivation in the fields of green plants rich in chalk. The last owe their flourishing condition essentially to the bio-dynamic treatment and to organized manuring. The qualities of the plants have grown stronger and with this the supply of chalk to the feeding animals. Beginning with dynamic treatment and manuring, fodder of proved excellence resulted year by year.

Similar is the healthy effect of the Weleda chalk fodder which has only some 5 per cent carbonic acid. But clearly the improvement of fodder and the addition of one hundredweight of chalk fodder (with 5 lb. of carbonate of calcium) yearly are not the sole causes of the good bone structure in a herd of 32 animals.

Herd and soil influence

Chalk actually takes a low place in the natural foundations of the Marienhohe herd. Consequently, one must again revert to the

close and manifold connection between herd and soil influence, which are so noticeable in their effect on the peculiarly gravelly land of Marienhohe. We know today how such a soil is able to transfer the strength of light and warmth. It is thus effective in the delicate chemical processes of life. In the plants themselves, one sees how they take on some of the growth and form of alpine plants and those growing in abundant clear light. Also it is known that in animals, high land builds a special character with strong bone formation and this not only on chalky ground, but on primitive granites, etc. and sandy ground. We also know how helpful light is to the cure of rickets and tuberculosis in human beings. In both cases, the healing results from a new arrangement of the chalk. If we go amongst northerners with their long season of light, we see a like effect. The Eskimos, in spite of their fleshy diet, have excellent teeth. It seems amongst them the influence of light on chalk must be of the first order.

Cosmic nutrition

Made observant of this phenomenon, we see again the effect of rays on chalk structure. This can no longer be thought of as a secondary effect, but rather its whole consideration has to be recast. A new knowledge of the nature of the organism opens out. In addition to the accustomed view of material nutrition comes a wider one. We learn from the effect on the sound bodies of animals that this health is linked up with cosmic influences.

How effective this cosmic nutrition can become, perhaps is also made clearer by our results in Marienhohe.

While we were able to bring into a sandy soil a sound humus and an increase of vital chalk, so the impoverished earth became the birthplace of remarkable health, soil and animal physiology united in benefiting from cosmic influences.

The sandy area arrived at a new significance. Its poor value need no longer be considered axiomatic. Really good husbandry may be got from it. It is high time that this neglected type of land is opened up more and more as a giver of strength.

Men are today continually threatened in their health. The development of the qualities to be found in the sandy soil is an increasing need. But this treasure can only be unearthed from the ground by means of a self-contained farm founded on bio-dynamic farming.

THE SAN JOSE SCALE AND ITS CONTROL IN KASHMIR

By M. R. Fotidar, M.S. (Horti.) (Calif.), F.R.H.S., M.H.S.S., M.S.H.S.
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The San José scale [*Forbesaspis* (*Aspidiotus*) *perniciosus* Comst.] is the most important pest of fruit and other deciduous trees in Kashmir. In the Valley of Kashmir alone there are about 20 lakhs of deciduous fruit trees which cover an annual production of fruits worth over Rs. 25 lakhs excluding dry fruits. During the last two decades the insect has played havoc with all the fruit orchards in the Valley and only a few years back a good many valuable orchards had been cut down as a result of attack made by this insect.

How it came to Kashmir

In Kashmir it is believed that the San José scale made its first appearance in 1910. The insect was for the first time officially reported by the late Mr R. Gopal, then Director of Agriculture, in 1921. This preliminary identification was later on confirmed by H. H. Morison of the Bureau of Entomology, Washington, U. S. A. As to how the insect got itself introduced in Kashmir cannot be definitely traced. Opinions differ in this respect. It is very probable that the insect was introduced into Kashmir along with a Japanese ornamental plant known as *Cydonia japonica*, which gets a very severe attack of this scale. This assumption is based on the fact that such ornamental plants were generally imported from foreign countries by the European residents living round about Srinagar. The above-mentioned plant is highly susceptible and is now almost extinct in the Valley. The Scale has now spread almost all over the Valley and has become endemic to Kashmir but there is little doubt that the scale got its entrance into Kashmir on some infected imported plant.

Insecticide used

It was in 1923 that Mr B. Fletcher, then Imperial Entomologist, visited the Valley at the invitation of the Kashmir Government and undertook the investigation of the insect pest. He conducted the investigations on control measures for about five months and evolved a recipe of crude oil, rosin, soda, soft-soap and tobacco-decoction which was adopted by the Department of Agriculture, and used as insecticide spray for about seven years. Even after this treatment the insect had an unobstructed progress in its dispersal, inasmuch as it is found at present attacking almost all the deciduous fruit trees, shrubs and ornamental plants all over the Valley. Further investigations and experiments were reorganized on the inauguration of the Entomological Section in the Department of Agriculture and it was in 1931 that a more effective insecticide was evolved.

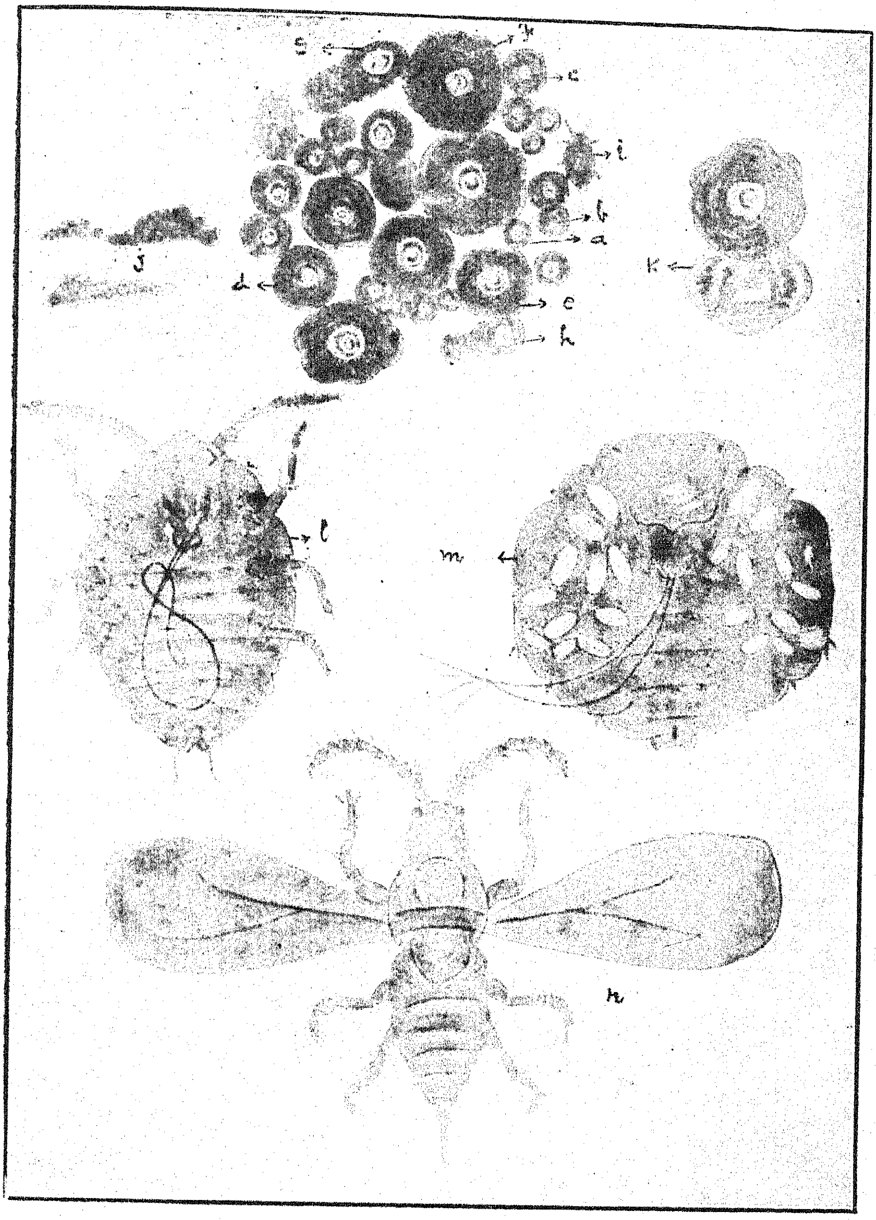
Host plants

Field observations on the host plants up-to-date have revealed that (1) the plants most susceptible to the scale are: *Cydonia japonica*, currants, foreign varieties of apple (*Pyrus malus* Linn.); peach (*Prunus persica* Stokes), pear (*Pyrus communis* Linn.), hawthorn (*Cratægus* sp.), willow (*Salix* sp.) including osier, lilac (*Syringa vulgaris*), quince (*Cydonia vulgaris* Pers.), gooseberry, rose, plum (*Prunus communis* Hudson), and greengages (*Prunus* sp.).

(2) The susceptible kinds are: *amari* (local) apple, walnut (*Juglans regia* Linn.) young plants only, almond (*Prunus amygdalus* Stokes) young plants only, cotoneaster, privet and cherry (*Cerasus vulgaris* Mill.).

(3) Rare cases of susceptible plants not subject to damage by the pest are: Apricot (*Prunus armeniaca* Linn.), grapes (*Vitis vinifera* and *V. americana*), mulberry, fig, poplar (*Populus* sp.), *Actæa spicata*, and *Rubenia pseudoacacia*.

(4) The immune deciduous trees are: chestnut, horse-chestnut, hazelnut and *chinar* (*Platanus orientalis*).



San José scale and its life-history

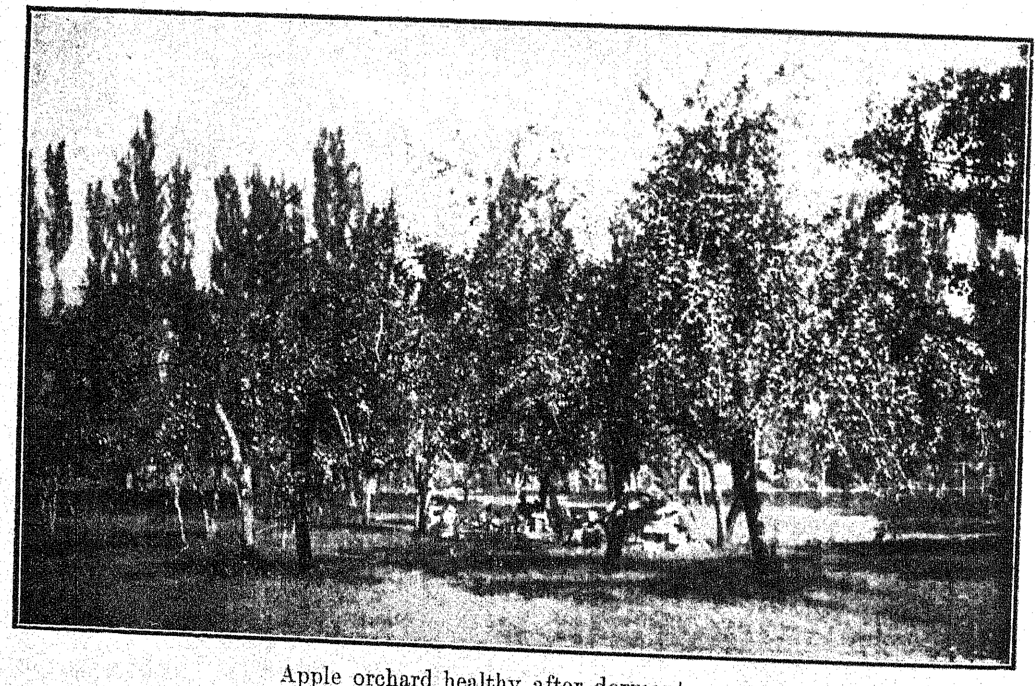
a. Young scale of 48 hours
c. Eight days old scale
e. 20 days old scale
g and h. Male scales
j. Male scale, side view

l. Nymph, enlarged view
n. Winged male enlarged

b. scale of 96 hours
d. 12 days old scale
f. Mature female scales
i. Young nymph
k. Female scale removed showing the mature female insect underneath
m. Mature female with young ones

Spraying being done in an orchard

A diseased unsprayed apple orchard



Apple orchard healthy after dormant spray

Symptoms of attack

On introducing its tiny stylet into the plant tissue the insect starts sucking the plant juice. Each and every insect individually may extract a negligible quantity of sap, but on taking into account so many hundred thousand of insect suction pumps stealing the essentials of the plant life, one can easily imagine the drain to which the host plant is subjected. It is due to this drain that the plant finally succumbs within a few years if neglected.

In early stages of infection the scales are few and scattered and are generally overlooked by a layman unless a careful search is made with a hand lens. In the later stages of infection the scales get overlapped and settle on the leaves and fruits, giving them a characteristic appearance with red spots on the fruit and ashy-grey scum on the infected stem and branches. It is at this stage when the infestation gets perceptible and prominent to the eye.

Life-history

The San José scale is a tiny, yellowish insect covered with a greyish scale. The scale varies in size and colour according to its age. The insect passes the major part of his life under this scale. In Kashmir the insect hibernates during the winter from the end of November to the middle of March. It appears that only those nymphs which are one to two weeks old survive the winter and the rest, whether very young or grown up adults, perish as a result of the cold. In the middle of March the hibernating nymphs become active and the male and female scales begin to differentiate, the former with an elongated scale with a nipple-like elevation towards one side and the latter circular with the nipple in the centre. The male adult emerges towards the end of April as a tiny two-winged insect. It fecundates with the female and dies. The fecundated viviparous female begins to lay the young ones by the end of May and continues to do so for about a month, till about 150-250 young ones are produced. At the completion of this work the mother scale dies, leaving the daughter scales to repeat the cycle. This repetition continues till about the middle of November when hibernation begins. During the active period of six months in Kashmir the insect passes three to four generations, each generation covering about 45-52 days.

The newly hatched nymph (crawler) is a yellowish, oval creature, very small in size, just visible to the naked eye if carefully watched. It possesses three pairs of legs, a pair of feelers and a curved thread-like rostrum. In its early stage it crawls for about 5 to 35 hours in search of a suitable place where it finally settles. It inserts its long, slender stylets into the plant tissue and begins to feed on the plant sap. Within a few hours of its settling it begins to secrete a waxy protective covering which is completed by about the fourth day. In about 12 to 20 days the insect moults, and in about 18 to 20 days the male and the female insects begin to differentiate. Within the next 30 days the insect comes to maturity and starts reproduction.

Methods of dispersal

The female scales are fixed and therefore cannot carry the infection from place to place. The males are winged and go from place to place in search of females exclusively for the purpose of fecundation and as such they too cannot spread the infection. The only agent for its dispersal are the newly hatched crawlers. On the same tree these crawlers move from affected to unaffected parts and settle down. They are also carried from tree to tree and to the neighbouring orchards by strong winds, by birds such as the *bulbul* (*Molpastes leucogenys* Gray); the *myna* (*Acridotheres tristis tristis* Linn.), the crow (*Corvus splendens splendens* Vieill); by other insects such as hoppers, ladybird beetles, ants, etc. and by squirrels. At fruit-picking time they are carried by pickers on their clothes, baskets, ladders, vehicles, horses and other livestock. The principal means of their dispersal from one region to another are the nursery plants, stock, scion, cuttings and grafts.

It has been observed that if any branch is removed the insect dies in all stages with the drying of the branch. The scales which are on leaves in the last brood also die with the drying of leaves at the time of leaf-fall.

Natural enemies

The scale is subject to attacks by several predators and parasites such as ladybird beetles and Chalcidoid wasps. Two species of the beetles appear to be *Jauravia binotata* Gorh. and *Chilocorus bijugus* s. sp. *infernalis* Muls. The species of the parasite so far known is *Aspidiotiphagus citrinus* (Crawford). The check exercised by these natural enemies is not sufficient to control the far greater population of the scale which has an enormous rate of reproduction as compared to those of either the ladybird beetles or of the parasites.

The control of the scale is, therefore, accomplished by insecticides generally used as dormant spray. Lime-sulphur was well-known as a spray material against the pest in the past and in fact application of lime-sulphur against San José scale in the United States of America has been a landmark in the use of insecticides for the control of insect pests in general. Later on, oil sprays were found more effective and economical. The use of Burma Shell diesel oil A as a spray material had a very good effect in destroying the scale insect in all the orchards treated in Kashmir. This is the standard uniform brand of cheap mineral oil available in India.

Diesel oil emulsion

In the preparation of the emulsion two standard ingredients, diesel oil and potash-fish-oil soap are used. Diesel oil resembles the American spray oil in all respects. The viscosity and flash point of the oils have been found to be almost the same; the only difference observed lies in the presence of a little higher percentage of unsaturated hydrocarbons in the diesel oil, but as far as the efficiency is concerned, it has given equally good results. The formula is:

Diesel oil	$1\frac{1}{2}$ gal.
Potash-fish-oil soap . . .	1 lb.
Water	$1\frac{1}{2}$ gal.

One and a half gallons of soft water is heated in a cooking vessel or ordinary kerosene oil tin. When the water has come to a boil, one pound of fish-oil soap is added to it, and thoroughly stirred till the soap is completely dissolved. To this boiling solution of soap $1\frac{1}{2}$ gallons of oil is added slowly, and the whole is stirred till the oil is well mixed, when the charge is removed. The hot solution is pumped in till a homogeneous emulsion is prepared. For dormant spray this stock solution is diluted in seven parts of water (1 : 7) before it is sprayed on the trees. For summer spray a dilution of 1 : 24 is adopted.

In Kashmir plants are sprayed by means of a local bucket spray pump, which is adjusted with a spray gun, and gives a jet and a mist spray, as may be needed, by working the handle one way or the other. These adjustments have been made to suit the local conditions and the improved bucket pump evolved has been found very useful and handy to carry from place to place.

Spraying experiments

Spraying experiments using various dilutions and temperatures in the dormant season were conducted to find an exact dilution and temperature to get 100 per cent mortality results. At the end of these experiments it was found that 6 per cent oil used at above 40°F. gives about 100 per cent mortality. Well-sprayed orchards under such conditions had a healthy appearance in summer, with hardly any symptoms of the disease on the trees. In Kashmir spraying is continued till the bud-sprout season which comes sometimes in the month of April. Summer spraying is also resorted to in certain cases where the trees are heavily encrusted and some scales not killed by previous (winter) spraying or reinfection has taken place by the scales carried by the wind. In this case 1 : 24 dilution is used.

Among other insecticides, Whiz, a ready-made oil emulsion, has also been effective when used at 1 : 24 and 1 : 40 dilution for winter and summer sprays respectively.

For an effective control of the scale His Highness' Government has promulgated the Crop and Plant Act No. 1 of 1933-34 (1990). Under this Act all the fruit plantations including new ones are sprayed. The growers have to provide at their own cost ingredients of the insecticide which are made available at all convenient centres throughout the state at uniform rates. The Government on their

part supply machinery, technical labour and other assistance free of charge. On an average about seven lakhs of fruit trees and four lakhs of nursery plants are sprayed annually. The growers spend a sum of about Rs. 20,000 for the purchase of insecticide and Government spends about Rs. 8,000 for the supply of machinery and technical labour for spraying the trees belonging to the growers. Under this Act the movement of live plant material and nursery stock is possible only with departmental permission. The Act is worked by the Central Plant Protection Committee assisted by local tehsil committees. All these committees have about 50 per cent non-official grower membership.

The cost of spraying per plant works out as under:

Age of plant	Number of of plants sprayed per rupee
Nursery plants	400·0
Small trees, 4 to 10 years old .	43·0
Medium trees, 10 to 20 years old	7·4
Big trees, 20 years and above .	3·5

The cost of spraying per plant includes labour charges, cost of wood fuel used for the preparation of the stock-solution and the depreciation charges on the spraying machines and other accessories. The cost of spraying has been worked out at the following rates:

Diesel oil—Rs. 3-12 per tin of 4 gallons.
Fish-oil soap—Rs. 32-8 per maund.
Fuel—4 maunds per rupee.
Labour—6 as. per day.

On the basis of calculations already mentioned, the average cost per plant, four years old and above, amounts to nearly one anna per season, which is in no way incommensurate with the average income of Rs. 1-6 per tree. It is therefore considered that the cost of spraying is economical. Its efficiency can be well imagined from the fact that nearly 750,000 trees are being sprayed annually in Kashmir province alone.

Further investigations on these lines have been started by the Department of Agriculture with the help of the Imperial Council of Agricultural Research. A research station has been opened to work on the survey of control and other connected problems.

HOUSEHOLD INSECT PESTS AND THEIR CONTROL

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THE Cockroach is a cosmopolitan pest. cockroaches are quite common in houses in northern India, but the damage they do is relatively small. Their presence, however, is very objectionable and annoying. In Bihar, Bengal and other parts in which the climate is comparatively hot and moist, they do considerable damage and are therefore considered as among the worst domestic pests.

Several species of cockroaches occur in India, *Periplaneta americana* L. (Fig. 1) being the most common. This cockroach is distributed almost all over the world. The other common species in this country is *P. australasiae* Fab. (Fig. 2) which is confined almost only to southern India and Ceylon. *Blatta orientalis* Linn. and *Blatta germanica* Linn. and *Stylopyga rhombifolia* Stoll. are also likely to be found in some parts of India.

The cockroach: description

Cockroaches are flattened insects, with horny, smooth and slippery bodies and large spiny legs for fast running. Their colour is generally brown or dark brown. The head is inflexed under the body and the antennae or feelers are long and slender. The mouth parts are well developed and include strong biting jaws which enable these insects to eat all kinds of food. They are omnivorous insects feeding on almost any dead animal matter, cereal products and all sorts of provisions. Their favourite food is starchy material, such as bread and biscuits, and they do not spare the paste used in binding books, which consequently get badly damaged and disfigured.

They live in dark places hidden in cracks and crevices, in kitchens and pantries, under boxes or in cupboards. They are seldom seen during the day and come out mostly at night when they prowl about and do the actual damage. Heat, moisture, darkness and plenty of starchy food are ideal conditions for their breeding.

Cockroaches give out, wherever they occur in some numbers, a fœtid, nauseous odour, well known as 'roachy odour' which is persistent and cannot be removed from shelves and dishes without washing them with soap and boiling water. Foodstuffs are unpleasantly tainted beyond redemption.

Life-history

The life-history of almost all the species named above is generally similar in essential features. Cigar-shaped eggs are laid in small bean-shaped capsules inside which they are arranged in two longitudinal rows (Fig. 3). The number of eggs in a capsule varies in different species.

The eggs hatch in about two days during summer, but in winter the incubation period may be several weeks. The freshly hatched young ones are often kept together by the mother and brooded over and cared for. These young cockroaches or nymphs (Fig. 4) pass through a variable number of moults or change of skins, as they grow. After some time their wings start developing, but they do not acquire full size till the individuals become adults. The period which elapses between the hatching of nymphs and their reaching the adult stage is variable, depending upon the climatic conditions and food supply. Generally there is only one generation in a year.

The abundance of roaches is, therefore, not so much due to the rapid rate of multiplication but because of their being able to preserve themselves from ordinary means of destruction. Their flattened bodies enable them to get entrance through very narrow cracks and crevices to take shelter against the attack of enemies.

Control methods

Scrupulous cleanliness of the kitchen, pantry,

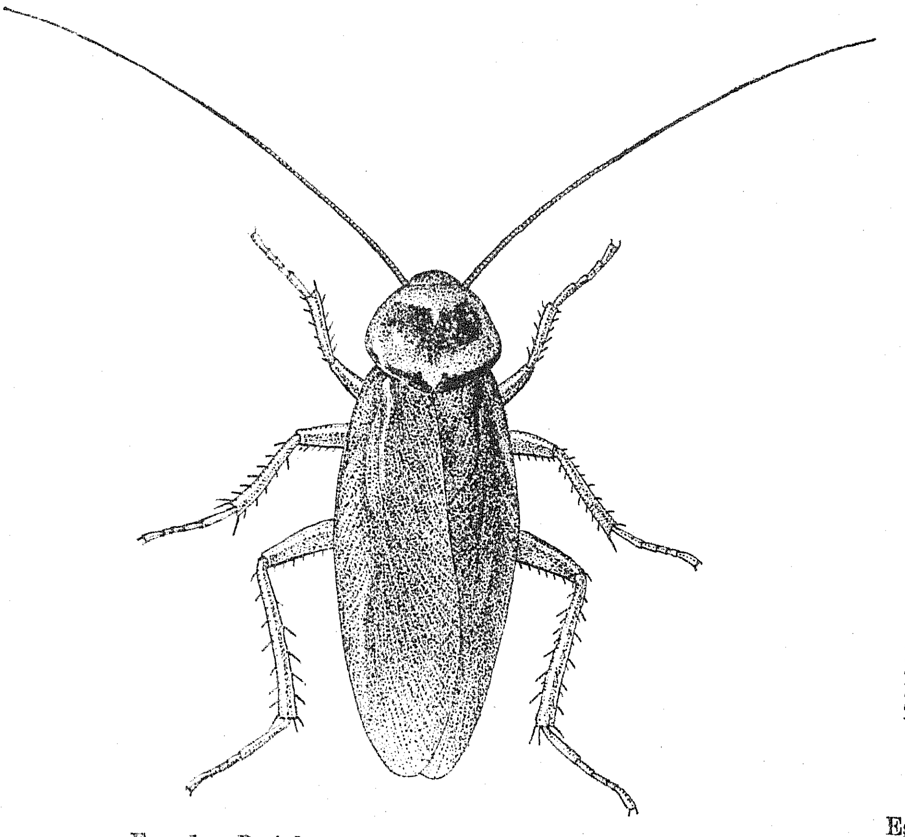

FIG. 1. *Periplaneta americana* L. (Adult stage) $\times 1\frac{1}{2}$

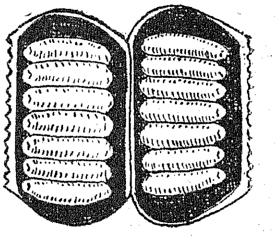

FIG. 3.
Egg-case with two longitudinal rows of eggs $\times 3$

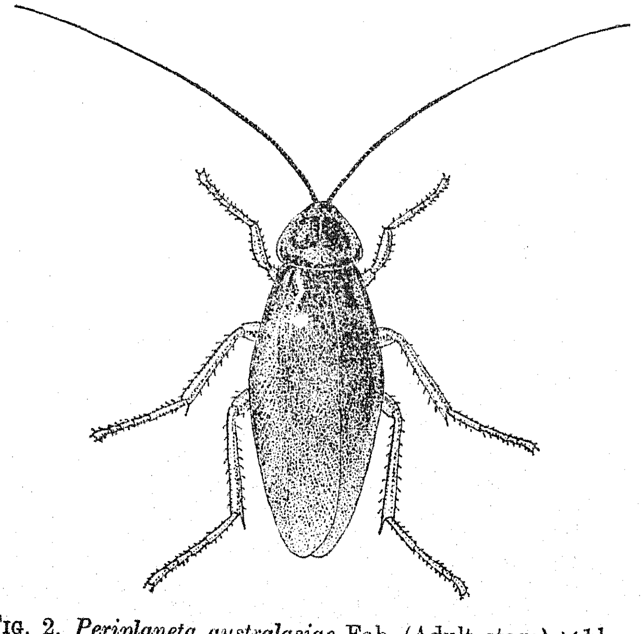

FIG. 2. *Periplaneta australasiae* Fab. (Adult stage) $\times 1\frac{1}{2}$

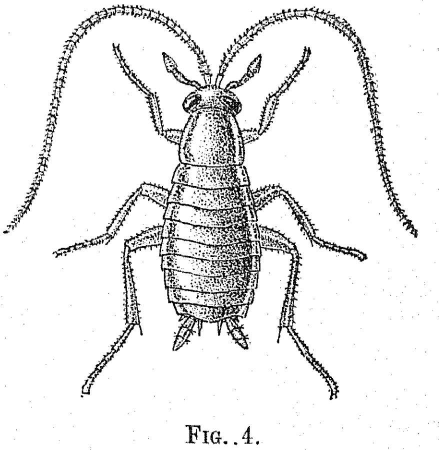

FIG. 4.
II instar nymph of *Periplaneta americana* L. $\times 6$

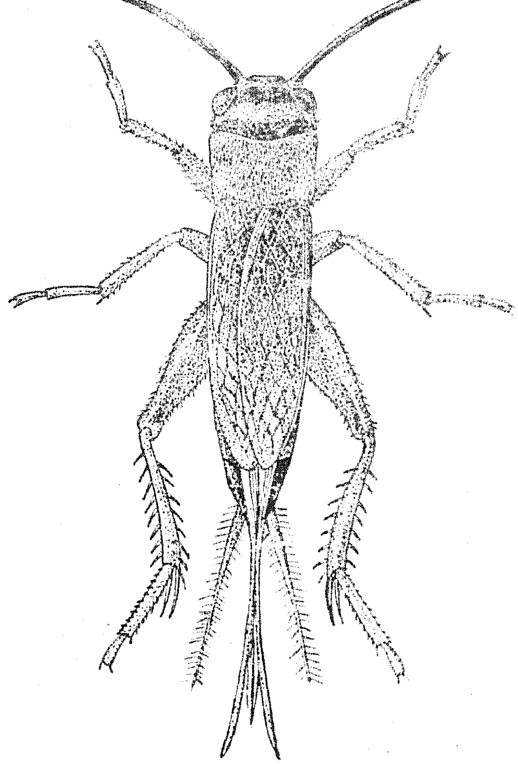

FIG. 5.
Gryllulus domesticus L.
(Adult stage) ×3

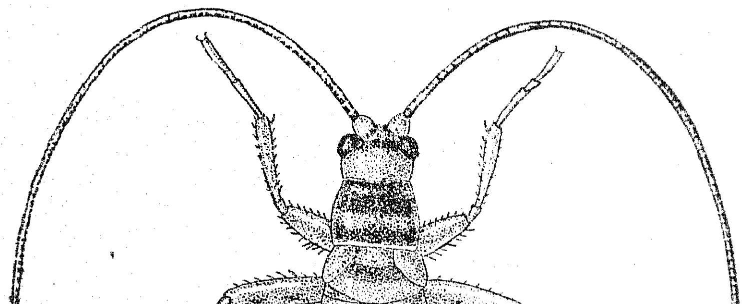

FIG. 7. *Lepisma saccharina* Linn. ×6

dining room, and keeping them free from unused and polluted foods and other refuse go a long way in reducing the number of these insects. For this reason all the remains after meals must promptly be removed to proper containers.

A variety of measures are advocated for the control of cockroaches and many proprietary substances in the form of sprays are reported to be effective in killing them. The best results have been secured by the use of commercial sodium fluoride, used in full strength or mixed with equal parts of flour. With the help of a dust gun or blower sodium fluoride can be thoroughly dusted over shelves, tables, floors and the runways and hiding places of the roaches. Its action is slow but sure as it gets stuck to their feet and from these gets into their mouths and so poisons them. However, good care should be taken not to let the poison mix with human food. It is, therefore, advisable to add a colour to the powder so as to distinguish it from other powders in the kitchen and pantry, such as baking powder.

Borax is also used in a similar way, but it is not so effective as sodium fluoride.

A mixture of one part of pyrethrum powder and four parts of sodium fluoride is very effective and acts more quickly than the pure fluoride but it is comparatively expensive.

Effective baits

Baits prepared in the following way have been successful in killing the large American roach :

Cotton-seed meal or linseed meal	1 pint
Molasses	3 tablespoonfuls
Water	Enough to make a thin paste

The mixture is cooked for a short time and allowed to stand until cool. A yeast cake dissolved in a cup of water is then added and stirred. It is allowed to stand in a warm place for about 12 hours in order that fermentation may get well under way. Then a teaspoonful of lead arsenate is stirred in.

This is ready now to serve and it should be placed in shallow containers used for no other purpose.

Since cockroaches are nocturnal in habit, this bait should be put out in the evening. The arsenate of lead should not be added to the bait until just before it is put out for the roaches. Bait made according to this formula is satisfactory as long as it remains in a semi-liquid or moist state. When the paste finally dries down it should be moistened and used again. It is most attractive to roaches when fermentation is at its height, gradually losing its attractiveness as the fermentation decreases.

Fumigation

Fumigation with hydrocyanic acid gas is very effective, but the gas being the most deadly of the fumigants has to be handled with great care. It is generated in several ways and has a wide variety of applications. However, it should not be used except under the supervision of an expert because of its dangerously poisonous nature.

Calcium cyanide, under the names 'cyanogas' or 'calcyanide' in the form of powder or flakes, which also gives out hydrocyanic acid gas, has great advantages. It can be handled more safely. It gives off the gas in the presence of atmospheric moisture so that it is necessary merely to expose it to generate the gas.

This powder is very useful. A little quantity of this powder blown into infested places acts very quickly. It gives off hydrocyanic acid gas which readily kills cockroaches. Two treatments with this material at an interval of a week or ten days gives complete kill in many cases. The dead individuals should be swept up immediately and burned, because cockroaches often recover from cyanide poisoning if the dose of the gas is not strong.

Carbon bisulphide fumigation is also recommended. Although many roaches may be killed, a large number of them usually escape from the house before the gas becomes strong enough to kill them.

The common sulphur powder dusted about the places where cockroaches abound has also been reported to be a very good repellant for this pest.

Various forms of traps have been successfully employed in England and on the continent of Europe. These devices are so contrived that the roaches can easily get into them but cannot come out. The entrapped individuals can be quickly killed by immersion in hot

water, etc. No good trap has yet been designed for use under Indian conditions.

The house cricket

Every householder is familiar with crickets, dull, straw or brown-coloured insects having black patches on the head and thorax. Crickets generally abound in cupboards and in the folds of hanging clothes. They are generally over an inch long and have long feelers (Fig. 5). The wings are deflexed and lie flat over the body when at rest. The extremity of the abdomen is provided with two long, slender appendages, and in the case of the female there is in addition a long and fine ovipositor with the help of which eggs are laid. Of the three pairs of legs, the hind legs are much bigger and are well suited for jumping.

In northern India there are two species commonly found in the house, viz. *Gryllulus domesticus* L. and *Gryllus sigillatus* Wlk. (Fig. 6). *Gryllulus domesticus*, popularly known as 'European house cricket', is also capable of damaging cultivated crops in the field. *Gryllus sigillatus*, however, is chiefly a species confined to the house and the damage done by this cricket is sometimes enormous.

Omnivorous habit

Like cockroaches, crickets are omnivorous insects. They feed especially on woollen and artificial silk fabrics, rendering them entirely unserviceable. Clothes damaged by them are so disfigured that they cannot be mended and used again. They also like starchy food such as bread, cakes, biscuits and flour, and like roaches damage books, especially their bindings, by eating away the glue or paste.

In some other habits also they are similar to cockroaches. They are seldom seen during the daytime, when they remain hidden in cracks and crevices, behind hanging clothes, wall-papers, pictures, etc. They thrive best in damp and warm places such as those in the kitchen. Parts of the house which are less frequently disturbed also become their favourite haunt.

They are found throughout the year but are especially active during the rainy season. Crickets are capable of living and breeding outside the house, especially under refuse dumps or in the gardens. With the onset of winter they migrate into the house where it is warmer. As regards *Gryllulus domesticus* L., it seems to breed always outside the house because only adults are found in the house while all the younger stages are seen in the field.

There is usually one complete generation in a year.

The female cricket lays eggs in clusters of about 30 eggs each. They are more or less cylindrical in shape and yellowish-white in colour. The young or the nymphs that hatch out of the eggs are in general shape similar to the adult except that they have partially developed wings. It takes about three months for the nymph to reach maturity, but this period may be longer under cooler and drier conditions. Both the young and the adult do the damage.

Control measures

Liberal sprinkling of naphthalene flakes in trunks, wardrobes and other places infested or likely to be infested by crickets will save the clothes from attack. A mixture of equal parts of finely powdered sodium fluoride, flour and sugar put in small trays in the places frequented by crickets is also very useful.

Crickets can also be controlled with poison baits made up as follows:

Lead arsenate or Paris green or Sodium fluosilicate	2 chattaks
Wheat bran (*chhan*)	$2\frac{1}{2}$ seers
Molasses	$\frac{1}{2}$ seer
Salt	1 tola

The ingredients are mixed together and moistened with about one seer of water. Frequently attractants, such as chopped whole oranges or lemons or essence of banana or amyl acetate, are added in small quantity to give flavour to the bait. Small quantities of the bait may be placed in shallow pans near the infested places. It can also be spread out in the gardens near the refuse dump or other places where the crickets breed. The bait must be spread only after dusk and when fresh and moist. What is left over by the next morning is useless and unattractive. It is always better if the bait is

prepared fresh before it is actually laid in dishes. The operation may be repeated after a fortnight or so for about three or four evenings.

The above bait is very poisonous, and therefore children and domestic pets should not be allowed to touch it.

The cracks and crevices in which the crickets may hide themselves should be as far as possible located and cemented permanently. If it is possible to locate their breeding holes, they can be treated with a fumigant as is recommended in the case of the cockroach. Even boiling water poured into such breeding holes will kill them.

Several proprietary preparations containing pyrethrum available on the market are reported to be effective. Such preparations are often very expensive. Moreover, since pyrethrum loses its insecticidal value rapidly both from exposure and with age, such insecticides cannot be regarded as reliable killers unless they have been prepared and preserved properly.

The silverfish insect

In common with other household insects these creatures are well distributed throughout the world. They are known by a variety of names of which the following are perhaps the most familiar 'Silverfish', 'Silvermoth', 'Sugarlouse', 'Sugarfish', 'Fish moth', 'Slicker' and 'Bristle-tail'.

The silverfish belongs to the most primitive group of insects and the species commonly met with is *Lepisma saccharina* Linn. (Fig. 7).

It is about one-third of an inch long, with the body tapering from the head to the tail end and is clothed with glistening silvery scales, which give the body a uniformly silvery-grey colour. The silverfish belongs to that class of insects (*Thysanura*), the members of which never acquire wings at any stage of life. There are two long, slender, many-jointed feelers or antennae projecting forward from the head and three long tail-like appendages extending backwards from the hind end. The mouth parts are better suited for scraping than for chewing purposes. The protective colouration of the insect, the rapidity with which it moves and the fact that the body is soft make it almost impossible to capture a specimen without crushing it.

They thrive in dark, moist places, shunning light, dry and well ventilated places. They feed either on vegetable or on animal matter, such as starch, glue, heavy-sized glazed paper, paste, etc. Their preference seems to depend largely upon the nature of food supply early in life. If they have habitually fed on starch they will maintain a steadfast preference for starch and will starve rather than feed on glue or any other material. Books left undisturbed for a long time in damp, dark places are readily liable to become infested, but those in frequent use often remain free from this pest. The silverfish also collect behind wall-paper and literally eat it off the wall by removing the paste used to fix it.

There are a number of ways by which silverfish may get into dwellings. Usually they are dependent upon infested material or containers used for transportation. Household goods, stored in warehouses, under ordinary temperatures, are liable to infestation and serve as an ideal means of distribution.

The life-history of silverfish is very simple. Each female usually lays 7 to 12 small, whitish eggs, in crevices and other concealed places. They hatch in 6 to 10 days and the tiny young ones generally resemble the parent, except in size. The development is completed in about nine months during which period the individual casts 6 to 7 moults. In temperate climates it may take as long as two years to reach maturity.

Control measures

Ordinary house cleaning and ventilation will keep their numbers down. The silverfish, like crickets, can be controlled by dusting their haunts with a mixture of one part of sodium fluoride and eight parts of flour. Powdered borax is nearly as effective as sodium fluoride, when dusted in their runways and hiding places, but it is slow in action. Borax has, however, the advantage over sodium fluoride in that it is almost non-poisonous to man and higher animals and it retains its killing quantities indefinitely.

PROPAGATION OF THE APPLE IN KUMAUN

By R. S. Singh, B.Sc. (Reading)

Horticulturist, Government Fruit Research Station, Chaubattia

EVERY apple-grower is familiar with the way the apple is generally propagated. If he desires to propagate a choice variety he knows that sowing seed of that variety will not fulfil his aim. He must either bud or graft the wood from that variety on to some previously prepared stock in order to get exactly what he wants. Why it should be so and why he should not get the offspring true to the parent plant by seed is a long story outside the scope of this article. Suffice it to say that the long time taken by the apple to come to the fruiting stage from the seed and its inherent complex constitution precludes the probability of obtaining a true breeding variety, within a reasonable time. Besides, its propagation by budding and grafting being so easy, it has not been considered worth while trying to produce sexually true breeding varieties. Propagation by seed is only employed when new varieties are being raised. As this is beyond the scope of the ordinary apple-grower, this method will only be described in the following pages in so far as it concerns raising of the stock for budding or grafting.

Cuttings not sound business

Amongst the various possible methods of vegetative reproduction to raise apple plants, there are some which are not commercially or economically sound yet. For example, with the present stage of our knowledge it is not possible to propagate the apple by cuttings on a commercial scale. Experiments are being carried out at this Station as well as elsewhere in the apple-growing countries to make this method a commercial success. We are, however, not in a position at present to recommend its general use as a means of propagating the apple.

Raising cultivated varieties of apples by layering (burying the attached twigs in the ground to induce them to root) is expensive and takes a long time with most of the varieties. This method also is, therefore, not described here. The two most common methods of vegetative propagation of the apple are by budding and grafting, and these two will be discussed here.

A budded or a grafted apple plant must necessarily consist of two portions: (*a*) the portion that supplies the root system, known as the stock, and (*b*) the above-ground portion that has been budded or grafted on to the stock and that forms the shoot and produces fruits, known as the scion. A knowledge of the propagation technique employed to raise apple plants will, therefore, consist of the knowledge of the propagation methods for raising stocks and of the various methods employed in budding or grafting the scion on to the stock.

Propagation of the stocks

In Kumaun the stocks for the apple are almost invariably raised from seed. There are two sources from which seeds or pips of the apple are obtained:

(i) From the wild crab apple: Some orchards in Kumaun have crab apples planted in them and the seedlings raised for stock purposes are invariably crab seedlings.

(ii) From any variety of apple: this is most common. It is commonly believed that seedlings of crab apple are more vigorous. It is possible that this may be true in some cases, but types just as vigorous may also occur in the seedlings obtained from the mixed seeds of any variety.

Seeds may be collected from any variety of apple, as long as they are sound. The writer has, however, noticed seeds being collected from absolutely rotted apples. Such seeds are poor in germination and should not be used.

As soon as damaged and useless fruits are

obtained their pips should be taken out. Although it is best to sow them as soon as possible, the weather conditions in Kumaun do not permit it. The fruits ripen here during the monsoon, and if the seeds are sown just then, there is every likelihood of most of them rotting down. They have, therefore, to be necessarily stored for some time. The best way to store them is to air-dry and keep in sand in flower pots or boxes till the time of sowing.

Sowing of seeds

Only well developed and plump seeds should be sown. The old method of throwing the seeds in water or a weak solution of salt, contained in a jar, and selecting only those that sink to the bottom, discarding all those that remain floating is as good as any other for the selection of seeds.

Select an open site and one that has good drainage for the seedbed. Prepare the ground finely and sow the seeds in drills 1 in. deep and 3 in. between seeds. Cover them with a little leaf mould and moist wood ashes and then fill in the drill. The distance between two drills should be about 9 in.

The best time for sowing in Kumaun is just after the rains and before the frost comes on. October may be considered the best month for this purpose.

In the middle of November or so, just before the frost begins to appear, it is a wise plan to spread tall loose grass or leaves from the forest all over the seedbed to protect the seeds from frost. Remove this covering after the danger of frost is over in February. The seedlings will begin to appear by the end of March or beginning of April. Constant attention is then required to keep the beds clean of weeds and sufficiently, though not over-moist. Too much moisture at this stage brings in root-rot.

A small proportion of these seedlings will be good enough for budding in September. These should be budded in the beds. A large proportion, however, will not be suitable for budding or grafting, till the following May or next September. All the seedlings, whether budded or unbudded, should be transplanted at the end of November in nursery beds 6 in. apart and 1 ft. between the rows. Out of the unbudded seedlings some are utilized for budding in May and some in the following September. Those that are fit enough are utilized for grafting in March the following year. Thus, with the majority of seedlings, it takes fully two years before they are good enough for being utilized for budding and grafting.

Disadvantages

Raising the stocks from seed has advantages. There are, however, certain disadvantages which are not generally recognized and which affect the future plantation. It is, no doubt, an easier and simple operation, but the considerable variation that is usually to be found in the size and character of the plants so raised at once offsets the saving in labour required to raise them. Even if a rigorous selection is made from the seedlings and only those that appear strong and uniform are used for propagation purposes, it is found later on that variations have cropped up which can only be attributed to genetic differences. These variations are just as undesirable to the practical grower as they are to the experimenter. Supposing it is desired to plant a block of apple, variety Delicious. The usual spread of this variety is 20 ft. If the plants are propagated on seedling stock with their inherent variation, it is possible that some of them will spread to 10 or 15 ft. only and others to even 25 ft. with the result that the plantation will give a patchy appearance. One can never be sure of the stocks raised from seed.

As already pointed out, another disadvantage of raising stocks from seed is that only a very small proportion of the plants, in seedbed, is large enough or of suitable size for budding or grafting at the end of the first season. Therefore, it takes a longer time to get plants ready for planting out from stocks propagated from seed than from those propagated vegetatively. These two points in themselves justify the recommendation that the use of seedling stocks for the apple be discouraged as far as possible and vegetative propagation be taken up by nurserymen as well as by orchardists.

Vegetative propagation of stocks

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As already pointed out, another disadvantage of raising stocks from seed is that only a very small proportion of the plants, in seedbed, is large enough or of suitable size for budding or grafting at the end of the first season. Therefore, it takes a longer time to get plants ready for planting out from stocks propagated from seed than from those propagated vegetatively. These two points in themselves justify the recommendation that the use of seedling stocks for the apple be discouraged as far as possible and vegetative propagation be taken up by nurserymen as well as by orchardists.

Vegetative propagation of stocks

Before taking up the vegetative propagation of stocks, it is essential to have a good

selection. Only those whose behaviour and performance have already been studied should be selected. East Malling Research Station, England, has made a selection of about 20 stocks whose behaviour they have studied thoroughly. Their conclusions, however, might not prove true to Kumaun conditions. An attempt is therefore being made at this station to select the best stocks for Kumaun. All the East Malling stocks have been imported, as also a selection from Russia. Local selections from the species of Pyrus growing in natural conditions in the forests of Kumaun have also been made. These are all being studied with regard to their various horticultural qualities. It is yet premature to say anything conclusively about them, but with the past four years' experience it can be said with a fair degree of confidence that the following six stocks will prove most useful here :

Crab C
Malling type XIII
Malling type II
Merton 779
Merton 793
Local Chaubattia selection type I

Out of these the last three have been found to be immune or very highly resistant to the attack of woolly aphis (American blight). The ravages of this pest can be considerably reduced in Kumaun if the apple plants are propagated on these stocks. The first three, although not immune to this pest, have other qualities which recommend their use. Crab C is a deep-rooted and vigorous stock. The trees on this stock are, therefore, less likely to suffer from drought in the hot weather than those on other stocks. The same applies to Malling type XIII. Malling type II, as far as our present knowledge goes, is a dwarfing stock. The trees on this stock are expected to bear fruit sooner than those on the others.

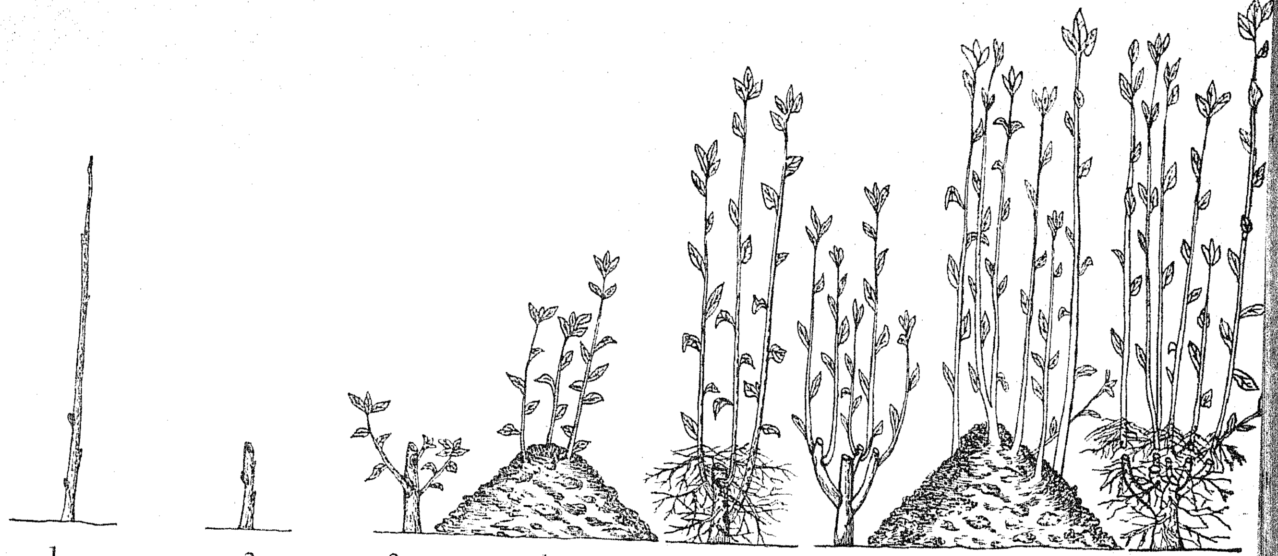
It is evident that these stocks must be propagated vegetatively, if their qualities are to be retained. Having selected any or all of them according to his requirements, the orchardist should proceed to obtain a few plants of the selected stocks. He can then multiply them in his own nursery. Stooling and layering have proved quite satisfactory for raising stocks vegetatively.

Stooling

In order to establish a stool bed, plant the young stock plants in November two feet apart in rows, each row being 3½ feet from its neighbour. The site selected for stool beds should not consist of hard clay. The lighter the soil the better chances there are of rooting. Of course the soil should be rich enough to provide sufficient food material for the crop of plants coming on from these stools. Tip the plants after they are planted and let them grow for one season. This is very essential, for it helps the would-be parent stools to establish themselves well before any crop of offsprings is taken from them. In the following November, cut them back to about two inches from ground level. In March or April when the growth starts, it will be seen that the buds from these two inches begin to sprout from the base of each parent plant. When these shoots are four to six inches high, cover them up with the surrounding soil to a depth of two inches, leaving the top two inches exposed. As these shoots grow, keep on earthing them, leaving only the top two inches exposed each time. Continue this process till the stool is covered up to six or eight inches. It is best to keep the soil slightly moist always, especially when the mounding is done. Never cover up the tips of the shoots or decay might result. After the full mounding is done there is nothing else to be done except keeping the bed clean of weeds and seeing to its water requirements. A reference to Fig. 1 will make the whole process clear.

Roots from the covered bases of these shoots start coming out by the middle of June and during the monsoon their number and growth increase rapidly till by the end of September, all the shoots have a good root system at their bases. In November, following the mounding operation, draw away all the soil of the mound, remove the rooted shoots from the stool, and plant them out elsewhere as required. These shoots should be removed to about two or three buds from their bases, which will sprout next year and provide the future crop of rooted shoots. If some shoots have not rooted at all, they should also be cut back to about two inches from the base.

FIG. 1



1 Young stock plant planted for stool and tipped

2 The same plant cut down to 3 buds next November

3 Growth in spring

4 Earthed up in spring

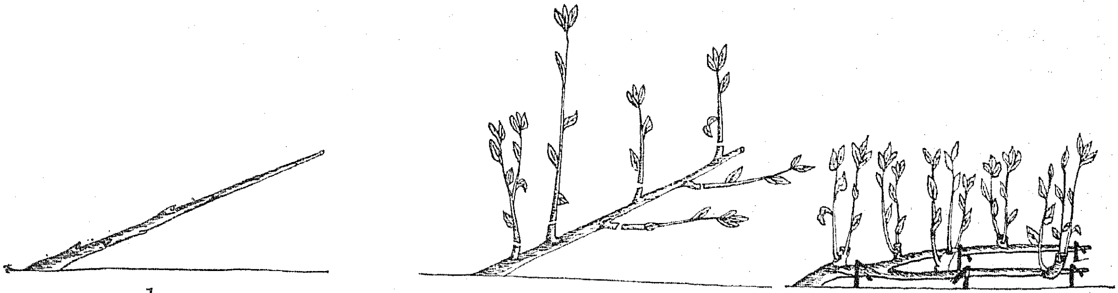
5 Rooted shoots ready in Nov. next

6 Growth in spring

7 Same as 4

8 Same as 5

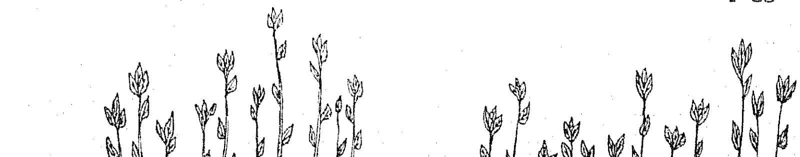
FIG. 2



1 Young stock as planted for layering

2 Growth of the stock plant in spring

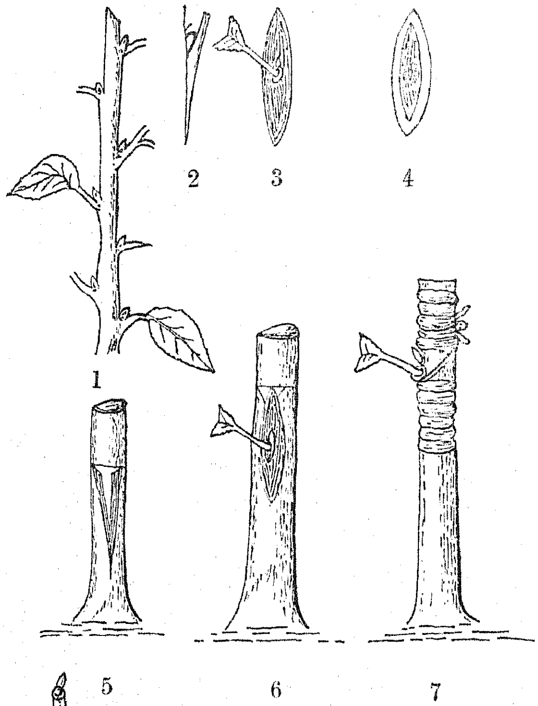
3 Main shoot and one of the side shoots pegged down in Nov.



4 Layered plant earthed up in spring

5 Earth removed. Rooted shoots ready

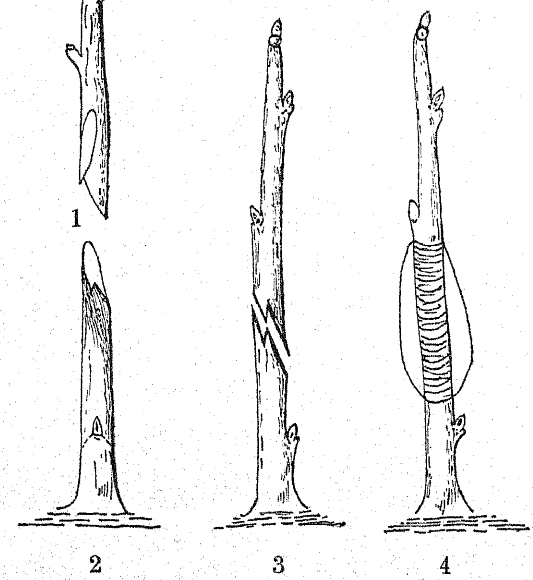
Fig. 3



1. Scion shoot as taken out for buds
2. Side view of bud taken out
3. Front view of bud taken out
4. Inside view of bud taken out

5. T prepared in stock
6. Bud inserted under the bark
7. Bud tied up. Operation complete

Fig. 4



1. Scion prepared for graft
2. Stock prepared for graft
3. Stock and scion as they should be fitted
4. Union bound and clayed. Operation complete.

Once the mound has been removed from the base of the stool, it is left exposed till the coming growing season, when again the same process of mounding up starts. Thus a stool planted up becomes more or less a permanent feature, and crops of young rooted shoots are taken from it year after year. It can be realized that this means a great strain on the parent plant and so a liberal dressing of farmyard manure should be given to the stool beds every year in November or December. If the parent plant tends to weaken even then, it is a wise policy to stop taking any crop from it for one year. This will restore its vigour.

Layering

The principle underlying the layering process is just the same as that of stooling, i.e. mounding up of the soil around the bases of young shoots to induce rooting. Plant the young stock plants obtained at a distance of four feet from one another in rows, the distance between rows being three feet. The plants are not planted straight but at an angle of 40° from the ground. Just as in stools, only a light tipping is given at the time of planting and the plants allowed to grow for one season. During the following winter the main stem and the strong laterals are lightly tipped, weak laterals are pruned to two or three buds from the base and the whole plant is pegged down into a shallow trench along the length of the row, so that the stems are about two inches below the ground level. When the new shoots from the buds on the stem have grown up to about four or six inches in the following March or April, mounding of soil round the bases starts, and is kept going, leaving only the tips exposed till about six to eight inches of the base is covered. Fig. 2 explains the whole process clearly.

The rooted shoots are taken out in the following November and planted elsewhere. A few buds at the bases of rooted shoots are left attached to the parent plants as in the case of stools. After the rooted shoots have been removed the whole plant is left exposed till the following March or April when mounding up of the shoots again starts and the whole process is repeated. This goes on year after year.

Layering requires more space and more care in handling than stooling, but it gives a greater crop of rooted shoots in return.

Our results on vegetative propagation of stocks have indicated that certain types of stocks will do better by layering and others by stooling. The guiding factor in determining what method should be adopted for a particular stock is its inherent vigour. If the stock is vigorous, it is best raised from layers. If it is on the weaker side, stooling is the more suitable method. Thus Crab C, Malling type XIII, Local Chaubattia type I and Merton 779 should be propagated by layering while the weaker ones like Malling Type II and Merton 793 by stooling.

Working the scion on the stock

Having obtained the necessary stock either from seeds or from stools and layers, the next step in the propagation of the apple is to work the scion on to the stock. This is done in two ways : by budding and by grafting.

The process of budding consists of the removal of a single bud from the selected scion and inserting it under the bark of the stock, so that both the cambiums are in contact. The season for budding is when the sap flow is quite active both in the stock and in the scion. The growth activity in Kumaun starts from the end of March or beginning of April, and continues till the end of September in a greater or less degree. Budding may, therefore, be performed any time during this period. To be able to bud early in the season, it is necessary that the scion from the prunings of the preceding season is preserved over the winter : for the new growth is not mature enough to be used as a scion before May. This is done by collecting the suitable prunings in winter and burying them in light soil at some sheltered spot. These provide suitable buds for budding in April. The plants so propagated are, in most cases, fit for being planted out in their permanent places by the following November.

Why early budding is successful

For budding later on in summer, new shoots which are mature by then, are used as scion, but they are not so successful as the earlier

budding, either with regard to the percentage bud-take or to the growth of the resultant plants. It is seldom that plants propagated later on in the season are fit for being planted out by the following planting season. There are two probable causes for this:

(i) The buds take up best in a dry but not too warm an atmosphere. This is just the type of atmospheric conditions in March and April in Kumaun. In the month of May, to start with, the atmosphere is very desiccating and the buds take a long time to establish themselves. In the meantime a large percentage of them dries up.

(ii) Although the growing season in Kumaun is more or less continuous from early April to the end of September, there is a distinct slowing down of the growth in the hottest part of summer. To start with we have a vigorous flush of growth in April. By the middle of May, it slows down and again starts vigorously after the rains have started. Thus the sap flow is not very active in May and this possibly is the other cause why budding is not so successful then.

The monsoon months are not very suitable for budding. There is every probability of the rain water getting in between the bud and the wood of the stock, causing decay.

Ideal month for budding

September is an ideal month for budding in Kumaun. Experiments carried out at this station show that budding in September is the best way of raising apple plants. There is practically 100 per cent success in bud-take and the growth which starts from these buds the following March or April is very vigorous and plants of very good size are obtained by the next planting season. Although the time taken to get plants fit for planting by this method is longer, it is always to be preferred, being more sure and yielding plants of extra good quality.

Method of budding

Collect the scion wood from the parent plant of the variety desired to be propagated or use the preserved prunings if budding in April. Cut them into small pieces about 6 in. long. Pinch off all the leaves, leaving only a small portion of their petioles attached to the scion wood. Put them immediately in a basin full of water to avoid dessication. Take it to the nursery where the stocks have already been raised. Take one piece out of the water and remove a slice of bark and wood from it about 2½ in. in length, containing a bud about the middle. Remove the wood attached to the bark of the slice by separating them at the one end and pulling off the wood. This should be so done as to leave the eye of the bud intact. This is a cushion-like green prominence at the seat of the bud. If while removing the wood, this is also removed, the bud is of no use and should be thrown away. The best way of leaving this eye intact while removing the wood from the slice, is to remove it with a jerk after bending it a little. After the wood is properly extracted the bud is ready to be inserted.

The next operation is to make a slit on the stock about one inch long with a cross cut either at the top, when it is called a T, or at the bottom, when it is called an inverted T. Various arguments have been advanced in favour of the one or the other, but there is nothing much in them. Both are equally good. While making the T the operator must be very careful not to injure the wood at all. The cut should just go as deep as the thickness of the bark. Next raise the bark from the wood by means of the flat end of the budding knife, insert the bud right under the flap of the bark and pull it down in the case of a T or push it up in the case of an inverted T, gently till it settles down snugly between the flaps. The cross cuts of the shield and stock should fit exactly. After this is done bind firmly with raphia or sunn, taking care to leave the bud itself free. The operation of budding is complete now. Reference to Fig. 3 will make the whole operation clear.

This bud will sprout after a few days if budding is done in the spring or hot weather, but will only do so after the winter rest, in the following spring, if budding is done in September.

After-care

When the bud has taken and shows signs of sprouting, it is a wise policy to remove the

portion of the stock above the bud in two stages. First, remove only the top portion, leaving a few leaves to draw up the sap. When the bud has actually sprouted and thrown out a few leaves remove the rest of the stock above the bud leaving but a small snag. This snag, later on, serves the purpose of a stake to which the sprouted shoot is tied up to make it grow straight upwards. Once, however, the sprouted shoot has attained the desired direction, the snag should also be cut down to the union. If this is done in July or August the wound calluses up by September.

Care should also be taken to remove the raphia or sunn, once the bud has taken, otherwise with the rapid growth of the stem in the growing season, it cuts down in the bark and weakens the shoot besides giving it an unsightly appearance.

Modifications in technique

Although this is the straightforward method of budding, various modifications are generally introduced by various people. There is a general belief in Kumaun that for September budding, a small thin strip of wood should be left attached to the shield in order to sustain it during the long period of rest that it has necessarily to undergo. Similarly, it is popularly believed that the wood should be removed completely from the shield for May budding, otherwise it obstructs the proper union. Experiments carried out at this station indicate that there is nothing in these beliefs. Budding with wood and without wood both gave identical results in May and September. The time of budding, however, gave a difference. As already indicated, September budding gave greater success.

As mentioned before, only a small proportion of the stocks raised from seed are fit enough for budding the first season. Most of them can only be utilized after $1\frac{1}{2}$ years from the time the seeds are sown. In the case of stocks raised vegetatively, the common practice in foreign countries is to plant them in nursery beds in November or December, when they are removed from the stool or layer beds, and bud on them the following spring. We find it more convenient to bud on them while they are still attached to the parent stools or layers. The shoots from the stools or layers start growing in April. They are earthed up as described before. By September they all attain the optimum size for budding. Buds are then inserted on these shoots which are removed in the usual way from the parent plants in November, and planted out in the nursery. The bud sprouts up in the following spring and nice healthy plants, fit for planting out, are obtained by next winter. This saves fully one year. The time saved and the quality of the plants obtained by this method are very much in its favour.

Grafting

There are various ways of grafting the apple, but they are all of the detached type, i.e. the scion is completely removed from the parent plant to start with and grafted on to the stock in any of the ways employed.

In mangoes and many other fruit trees, it is found essential to keep the scion attached to the parent plant for a considerable time after grafting, and sever it completely only when the graft has taken. This is called the attached type of grafting. With apples this is not necessary. So raising plants by grafting is easier in the apple than in the mango and its type.

Although various ways of grafting, e.g. Tongue grafting, Double tongue grafting, Wedge grafting and Saddle grafting, etc. are employed in the propagation of the apple, the principle in all cases is the same. That is, to bring the cambium of the stock and the cambium of the scion in direct contact with each other in order to bring out a union of the tissues of stock and scion. In the mature wood of the stock and the scion it is only the cambium that is in an active stage of growth. The other tissues have more or less stopped growing. So that in grafting it is essential to ensure that the two cambiums are in direct contact.

Cause of failure

A large proportion of the failure in grafting is due to the neglect of this point, either through carelessness or through ignorance. It is for this reason that the best success in grafting is achieved when the thickness of the

stock is the same as that of the scion. If, however, one is thicker than the other and the two cambiums cannot be brought into contact all over, the utmost care must be taken to see that they are so placed on one side at least. This is not at all difficult to achieve. If say the stock is thicker than the scion, its outer bark will also be thicker than that of the latter. Therefore to bring the two cambiums together, placed between the bark and the wood, make such a fit of the stock and scion that the edge of the latter stands a little within the edge of the former. In an equal thickness of stock and scion the bark of both should be kept flush all round.

Although many methods of apple grafting are possible and are practised at places, the most common method employed in Kumaun is Tongue grafting. Therefore, it seems superfluous to describe all the methods here. Tongue grafting only will be described and the reader is requested to refer to the literature on propagation if he is keen to know the other methods.

Time of grafting

The best time for grafting is the month of March in Kumaun, when the growth has not started but is likely to start very soon. Some orchardists and nurserymen graft in the month of August also, but we recommend March as the best month. The reasons for this recommendation are :

(i) Grafting in March means utilization of the prunings of the last winter for scion wood. The prunings are properly labelled at the pruning time and preserved till the following March as described earlier in the article. These can all be utilized for grafting in March. For August grafting, all the scion wood has to be obtained from the current year's growth. This means an extra strain on the parent plants when they are bearing fruit.

(ii) By experiments carried out at this station, it is found that the percentage of success in the grafts, and the subsequent growth of the scion in those that have taken is not so good in August grafting as it is in March grafting.

(iii) The August-grafted plants are more liable to suffer from the attack of woolly aphis at the point of union than the March-grafted ones. Woolly aphis is more or less kept in check in March, in Kumaun, due to the activity of the ladybird beetle. So it does not get a chance of establishing itself in the wound made by grafting. In August the activity of the ladybird beetle is considerably reduced. As a result the woolly aphis easily establishes itself in the wound and multiplies, making the plant weak.

Method of grafting

It is supposed that the stocks raised by either of the above-mentioned methods are ready to be grafted. Select only those that are vigorous and healthy. As a general rule the stocks for grafting are thicker than those for budding. Select the scions from the prunings of the previous winter. Only those that are still plump and well furnished with buds are chosen. Thin ones are discarded. Cut the selected shoots in six-inch pieces and place them in a basin of water.

Start the operation by cutting off the top of the stock to about 6 in. above the ground. Take a piece of scion out of the water and make a slanting cut at its lower end about two inches long. Make a similar slanting cut tapering upwards in the stock. This should also be two inches long, so that when the cut portion of the scion is placed against the cut portion of the stock, they should fit exactly. Then form a tongue in the stock by making a slanting cut downwards and inclining inwards, beginning a short distance from the top of the stock. Next make a similar tongue in the scion by making an upward cut. Fit the scion to the stock, tie firmly and smear with wax or clay. The operation is complete now. If the graft takes, it will sprout in about a week and the plant will be ready for planting out by the winter following. If two or three buds sprout from the scion, pinch off the lower ones and let only the top shoot grow. Fig. 4 depicts the full process.

The method, as described above, is rather a departure from the usual method of tongue grafting practised in Kumaun. Here a modified form of root grafting is practised. The stock is taken out of the ground at the time of grafting and the scion is fixed on to it by the

method described above, almost on the root. It is then covered with clay and planted out, burying the whole of the union underground. This process makes the operation easier. The percentage of success is also good but we do not recommend it because it induces scion-rooting and the effect of the stock on the scion is nullified. If seedling stocks are used it makes no difference but when clonal stocks are being recommended in order to produce some definite effects on the future behaviour of the trees, this method defeats the very purpose of using such stocks, and hence it must be discouraged.

After-care of grafts

As already pointed out, if more than one bud from the scion sprout out, keep the top one, and pinch off the others. After it has grown up, staking might be required to give it the right direction. It will be found that buds from the stock too sprout up. These should be constantly watched and pinched off. When the graft has taken well, remove the clay or wax and also the binding. If this is not done the sunn used for binding cuts through the bark and, besides disfiguring the plant, makes it weak.

No other care is necessary after this except keeping the bed clean and watered when necessary. The plants are ready to be planted out by the following winter.

The most common method of preparing grafting clay is to mix two parts of stiff clay, one part of cowdung and one part of horse droppings. After mixing, the material is allowed to remain in water overnight. Next morning it is taken out and beaten thoroughly and kneaded to make a homogeneous mixture. It should have the consistency of kneaded flour. A depression is made at the top of the mass after the first day's beating and kneading and some water poured in it and left overnight. The process of beating is repeated the next day and possibly the third day also after leaving it overnight as above. On the third day it is ready to be applied to graft unions.

Preparation of grafting wax

Out of the different formulas for the preparation of grafting wax, we have found the following most convenient and serviceable under our climatic conditions:

Melt 4 lb. resin, 2 lb. beeswax and 1 lb. tallow together over a gentle fire. Allow it to boil and mix thoroughly by stirring it constantly. When it is thoroughly mixed pour the melted material in cold water. When it has cooled down, knead it thoroughly until it becomes a buff colour. The wax is now ready. This can be kept for a long time by immersing it in water. Goat's fat can be used instead of tallow if the latter is not available. When using it, all that is necessary is to take a small quantity of it, rub it between the palms of the hand. It becomes pliable and can be applied to the grafts easily. We find that the wax thus prepared does not melt in the hot months of April, May and June as some other waxes do.

Grafting clay v. *grafting wax*

By experiments carried out at this station we have come to the conclusion that so far as the method of grafting recommended here is concerned, grafting wax gives a greater percentage of success. In the method recommended the graft union is allowed to remain about 6 in. above the ground and grafting clay, however well prepared, is liable to crack in the hot weather, admitting air inside, which prevents proper union. The wax effects a complete seal and the grafts as a consequence take on more readily.

Where the graft union is buried underground, as is at present done in Kumaun, grafting clay gives as good a result as grafting wax. With the increase in the use of clonal stocks, however, it will not be possible to bury the union underground for fear of scion rooting and in that case grafting wax must be used.

Budded and grafted plants

There has always existed a controversy as to whether a budded or a grafted tree is better in the long run. Experiments carried out at this station have shown that although the percentage take of scions is more in budded plants than in grafted ones, there is no difference between the growth produced by budded and grafted scions, once they have taken. No data either on the ultimate life of the trees

propagated by the two methods, or on their behaviour for any length of time, are available, but generally speaking, once the bud or graft has taken, there is little probability of any difference in their subsequent behaviour. It is simply a matter of convenience as to which method is adopted. In the writer's opinion September budding for propagation of the apple is the best. There is greater success. The amount of scion wood required is less than that required in grafting and the plants obtained are ideal for planting out by the end of November the following year. If, however, this has not been possible, and if the plants are required to be planted out by next winter, grafting in March is preferable to May-budding, for the March-grafted plants are sure to be ready for planting out by the following November while May-budded plants are not. Budding in May must be adopted as a method of raising apple plants only as a last resort. It has very little to recommend itself.

FARMING AFTER THE WAR

SOME time ago I was given the opportunity of studying at first hand the result of a critical examination of two quite different sorts of large-scale farming operations that have both been successful.

The first example was of mixed farming in Lincolnshire. It comprised more than 6,000 acres of what had originally been 25 separate farms. The farms had been gradually acquired and, in nearly all cases, the purchases had been made possible because the former owners were not making a success of it. Capital had been expended generously but carefully. In many cases fields had been combined to make sufficiently large cultivation units. A main farm road had been constructed with central buildings for stores, machinery and various operations, including workshops for different farm purposes. The records available covered a series of years up to 1930 during every one of which 5 per cent had been paid on the capital employed and a salary of £1,000 a year to the manager. In addition to this there had been a profit in every year but one.

It was manifest that these results had only been obtained through a much more intense use of the land and many more livestock were carried that existed on the previous farms; much of the grassland had become permanently arable; more had been ploughed for alternate husbandry or for re-seeding and a rotation of crops had been adopted, mainly in two groups, covering respectively periods of four and six years. The scale of operations naturally afforded opportunity for full use of the machinery, and the costing methods that had been adopted gave a clear picture of the whole plan of operations and of the respective importance of the different parts of it. One of the most significant things in this case, as in others of a similar kind, was that, contrary perhaps to expectations, the full use of machinery had not involved a decrease in the amount of labour employed. The more intense cropping and the increase in the number of livestock have involved additional labour. There was an increase of 34 per cent in the number of men employed full-time as compared with the total on the previous 25 farms and an increase of no less than 80 per cent in seasonal casual labour, particularly on the pea, potato, and beet crops. Moreover the system adopted had resulted in an average wage paid of 42/3 per week, or 10*s*. more than the country rate at that time.—The Rt. Hon. LORD ADDISON, P.C., in *The Field*, 12 October 1940.

RURAL RECONSTRUCTION IN SIND

By Abdul Nabi Gul Hassan Khan Agha, B.A.

Special Officer for Rural Reconstruction, Sind

RURAL reconstruction in Sind started in right earnest in 1938. In 1936, when the province was separated from the Bombay Presidency, the Government of India raised the question of systematizing the work of village uplift throughout India and of confining the expenditure to certain definite heads so that the activities should not be diffused over too wide a field without concrete results. The examination of the scheme took time and the scheme as finally modified by the Government of India was adopted in this province in 1937. In the same year, the provincial Government, to suit the peculiar conditions of this province, thought it necessary to set up a skeleton organization and to formulate a programme so that the work might be centralized and the maximum results achieved in return for the funds spent. A Special Officer was therefore appointed to guide the movement, district sudhar committees were set up, and small areas to be intensively developed through these committees were selected in each district. In addition, village committees were also set up so that villagers might be able to take their share in the supervision of work, raise their contributions in the shape of money or labour, and themselves suggest and initiate the works of improvement most required in their villages.

The necessary machinery and organization having thus been set up, the progress made and the results achieved are as follows.

The funds available for rural reconstruction are provided partly by the Government of India and partly by the provincial Government.

Government of India grant

The Government of India grant is spent on the improvement of water supply, on sanitation and hygiene and on agriculture and cottage industries. The most substantial progress made under the first head has been in the provision of tube-wells. More than 120 such wells have been constructed or approved for construction, the number being appreciable in the Hyderabad, Nawabshah, Sukkur, Tharparkar and Larkana districts. A number of ordinary wells have also been sunk and improved.

Under the second head, real progress has been made in the removal of manure outside the villages and storing it under modern agricultural methods, and the results are particularly notable in the four northern districts of Sind. In addition to this, village streets have been levelled and pits and depressions filled up. In some districts the villagers have begun to provide their houses with windows and ventilators. Village medicine chests (table dispensaries) continue to increase and are to be found in all villages in the selected areas, while in Hyderabad district alone there are 46.

Seed distribution

Under the third head, viz. agriculture and industries, the number of seed and implement depôts increased from 18 to 33. This is important in view of the fact that pure seed is still the greatest need of agriculture in the province. These depôts sold 18,933 maunds of pure seed of improved varieties of cotton, rice, wheat, *jowar*, *bajri* and oil-seeds and 588 improved agricultural implements. A new departure has been an endeavour to use the depôts for propaganda purposes by the exhibition of specimens of most of the improved seeds and implements required for the province. A beginning has also been made in the introduction of an improved poultry-breeding scheme from the funds allotted under this head. Orchards have been laid out in the selected villages of several districts and in others demonstration plots have been cultivated. Trees and

flower plants have been grown by the villagers in the selected areas in various districts.

As regards the Industries Department, the main activities have been rope-making, soap-making, tanning and beekeeping. It has been decided that soap-making is mainly an urban industry and the expenditure will henceforward be met from ordinary provincial revenues. Some work is, however, still being done in the villages. The demonstrator visited Nawabshah, Hyderabad and Upper Sind Frontier districts and 30-40 persons received training in those districts. A beginning has been made in the tanning industry by sending a local tanner to be trained at Bombay, and he is now imparting instruction in the Hyderabad district. Much is hoped from the introduction of the beekeeping industry. Bees have been imported from Travancore and the Himalayas and are being acclimatized in Karachi itself. So far the work done in the villages has been confined to demonstration but it is hoped, when the hives have been multiplied in Karachi, to distribute them to villagers.

Provincial funds

The funds provided by the provincial Government are used for the payment of the necessary staff of the Special Officer, the Sudhar Committees, propaganda work including village shows and exhibitions, the construction of model houses and model villages and other purposes not covered by the Government of India grant. District organizers, village readers and *kamgars* have been appointed in the selected areas of each district. The Special Officer and the Publicity Officer pay frequent visits to the selected areas where they give lectures and hold shows and demonstrations. Seventy-five model houses have been built as a pattern for the villagers to copy in various districts. The next step is the construction of model villages and three such villages are actually under construction. The starting of a literacy campaign gave stimulus to rural education and in addition to the opening of new schools and adult literacy centres, libraries have been provided in a number of villages. In several cases, industrial and agricultural bias classes have been established in schools. A novel feature has been the provision of circulating libraries in some districts. Among miscellaneous activities special mention may be made of the increase of Boy Scout troops in villages in the selected areas and the organization of Girl Guides. Junior Red Cross societies have continued to flourish, and in several districts more *dais* have been appointed. In regard to road-making, special mention may be made of a road one mile in length constructed by the villagers in Dadu district with a little assistance from the District Local Board. This was in addition to the work done by them in maintaining a road seven miles in length, previously constructed by them.

What the Scientists are doing

LARGE-SCALE FARMING

AT a meeting of the Pusa Agricultural Research Society held at New Delhi on 27 February 1941, Dr W. Burns, Agricultural Commissioner with the Government of India, delivered a lecture entitled 'Random Reflections'. This lecture dealt mainly with the possibilities of large-scale farming.

Poverty and lack of organization, said Dr Burns, were the chief handicaps of the Indian farmer, and his immediate requirements were technical help and business organization—requirements which were recognized as essential even to British agriculture. The stress of war had led to a public discussion of the present agricultural position in Britain, and recent contributions by Lord Addison to *The Field* showed a significant change in the trend of thought. Dr Burns referred to a correspondence in *The Times* initiated by Mr Bernard Shaw and followed up by Lord Bledisloe, concerning the comparative inefficiency of small-scale farming and the importance of the application of science to agriculture.

Dr Burns recalled that at the recent Cotton Research Workers' Conference in Bombay, Mr Y. G. Deshpande, a landowner of the Central Provinces, had asserted that it was impossible to get satisfactory yields of cotton or any other crop until there were economic-sized farms.

Dr Burns gave examples of certain large-scale farming enterprises in the Punjab and stated that, in one of these, yields of wheat were double those obtained on adjacent land.

The Project System* might be considered as a first step towards a better state of things. This method, which involves the simultaneous application of a variety of improvements in a village, might well lead not only to technical improvement but also to cooperative organization. For such a modernization agriculturally trained managers (similar to Continental *agronomes*) were essential.

If the students of agricultural colleges could, in addition to their college training, also obtain practical experience on large farms, there would be men available to lead such changes.

* See Indian Farming, Vol. II, No. 3, pp. 113-18.

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INDIAN SCIENCE CONGRESS

THE scientific work of the Indian Science Congress was transacted in fourteen different sections. Joint discussions were held between sections on different aspects of the social relations of science, notably on food-planning, literacy campaigns, the quality of crops in relation to nutrition, and reasons for the lag or delay in the utilization of medical (scientific) knowledge by the individual and the initial steps towards solving the problem, etc. The number of papers received and discussed varied from section to section. Chemistry topped the list with as many as 238 papers, Agriculture came second with 66 papers, while the youngest section of Engineering Research had 14 papers before it. The section of Medical and Veterinary Research was third in the list with 58 papers, of which only nine were classified under Veterinary Research. Besides, livestock matters were grouped under other sections of Agriculture, Entomology, Zoology and Physiology as well, and these included data regarding tape-worms of sheep, the cattle and horse tick (*Hyalomma ægyptium*), fowl lice, the economics of sheep and goat herds, milk and ghee supply, the consumption of milk in urban areas, and the effect of synthetic fertilizers on grasslands. Regrouping of sections engaged the attention of the session, and the proposal to alter the present grouping of Veterinary Research by transferring it to the section of Agriculture was advanced by the Executive Committee with the support of the Council but was thrown out by the General Committee as unsound and retrograde. It was explained from the veterinary side that though animal husbandry and agriculture come under the same Ministry of Government

for administrative convenience, the scope of the Congress was restricted to scientific investigations, and veterinary research was much more interrelated in its methods of approach and interest with medical science than with matters of crops and soils.

Infections of men and animals

Regarding the sectional papers, the large majority were of a highly technical nature, being designed to interest specialists rather than the uninitiated layman. The increasing incidence in an Indian city of a form of infectious jaundice or 'yellows' (which affect man and dogs through the intermediary agency of rats and is caused by a spiral-shaped microbe) formed the subject of two papers. In another paper it was revealed that the common guineaworm infection of man and animals (transmitted through the intermediary of the aquatic animal 'cyclops') could be controlled by the rearing of the larvivorous fish (*Rasvora*). This interesting method of biological control of this disease by employing another fish (*Barbus puckelli*) to feed upon cyclops and the worm larvæ was already known. The use of the new drug, sulphanilamide, and its derivatives in the control of diseases was discussed from all angles, and encouraging data regarding their use in outbreaks of human plague were presented. The brain and spinal disease, known as encephalomyelitis, and 'circling disease' of animals was thoroughly discussed in the light of experience in the Punjab, Kashmir, Bihar and countries abroad. The cause, whether a bacterium (*Listerella*) or a virus, remains undetermined though microscopical studies of the affected tissues are suggestive of the latter. The role of possible vectors such as mosquitoes, cases of relapse, and differentiation from other diseases were some of the other points discussed. The successful transmission of hæmorrhagic septicæmia (a most serious blood infection of Indian cattle due to a germ closely related to the bacterium causing human plague) through the agency of fleas in laboratory animals was reported in one paper. Discussion yielded information regarding outbreaks of rabbit septicæmia (snuffles), and also of the means of spread of the similar disease in sheep, where the causative agent is found only in the lungs and not in the peripheral blood, in this way excluding transmission by arthropods. It was admitted that fleas could transmit the disease under laboratory conditions, and the extent to which natural transmission through vectors takes place in the field requires to be investigated. Other subjects discussed included the part played by atmospheric oxygen, sunlight and enzyme (unorganized ferment) action in the destruction of carotene (a precursor of vitamin A) on drying of grasses, the regional distribution of warble-flies, the description of a new parasite from the fowl, the developmental stages of a round worm (*Mecistocirrus digitatus*) causing parasitic gastritis in cattle, the round worms known as *Trichostrongyles* from domestic ruminants, and the systematic position of the encysted organism, *Rhinosporidium*, which causes nasal polypus in man, cattle and horses.

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COTTON RESEARCH WORKERS

REALIZING the need for the various cotton research workers to meet occasionally and discuss the many technical and scientific questions connected with cotton improvement, the Indian Central Cotton Committee had organized a conference of workers for the first time in March 1937. The second such conference was held in Bombay from 20 to 22 January. There were over 40 contributions grouped under different subjects such as genetics and plant breeding, cotton agriculture, cotton technology, statistics and cotton pests and diseases.

Mr P. M. Kharegat, President of the Cotton Committee, presided over the meetings. To facilitate discussion, the papers had been printed and circulated to members well in advance, and at the conference the authors were given only five to seven minutes each, just to mention the salient features when introducing their papers. The conference was well attended, there being over 60 members present, including professors and staff of local colleges. At the end of the discussion on each paper, Dr W. Burns summarized the outstanding points arising out of the discussions.

Improvement of breeding technique

Under genetics and plant breeding, Mr K. Ramiah and Rao Bahadur V. Ramanatha Ayyar outlined the results obtained so far, the necessity for an intensive programme of hybridization and how the latest advance in the science of genetics should be taken advantage of in improving breeding technique. Dr V. G. Panse dealt briefly with the important question of the inheritance of quantitative characters in cotton. Two papers of cytological interest in this section dealt with interspecific hybridization and colchicine-induced polyploids in cotton by Mr K. C. Amin and the study of somatic chromosomes with special reference to nucleolar chromosomes as an aid in tracing the phylogeny and interrelationships in cotton by Dr Jacob. Mr Mohammad Afzal, in discussing the practical utility of collecting data on flower and boll production, came to the conclusion that the data he had examined were not of much value to the plant breeder in predicting cotton yields. Mr G. B. Patel gave a comprehensive review of cotton breeding in Gujarat and Mr S. J. Patel dealt with certain considerations on the question of breeding for earliness in cotton.

Economic holdings

One of the important points referred to in two papers under cotton agriculture was the question of growing mixtures of cotton and the experimental data collected at Indore and at Parbhani which would appear to indicate certain advantages in the practice of growing of mixtures although it is too early to recommend the practice to the cultivators. Mr Roger Thomas, in a paper entitled 'Some Odd Thoughts of a Cotton Grower', dealt with the practical difficulties of the cotton grower in obtaining maximum yields and drew attention to what the scientist might do to deal with some of them. Mr Y. G. Deshpande, himself a large cotton grower in the Central Provinces and a representative on the Indian Central Cotton Committee of growers' interests, asked certain questions regarding cotton soils, cotton yields and the eradication of *kans* grass. In the course of an interesting speech he pointed out that India could not compete in yields as long as Indian agriculture was run on small-scale holdings with neither capital nor trained intelligence. He recommended the raising of capital, the formation of large farms and said many people would be willing to hand over their lands if they could be shown a profit. Other speakers gave interesting facts regarding this same matter, including Rai Sahib K. D. Sawhney who described what was done by the Sudan Plantations Syndicate and Dr Burns who mentioned some recent articles by Lord Addison and a letter by George Bernard Shaw to the London *Times* of October 1st. The present position of the manurial trials with cotton in India was reviewed by Rao Bahadur D. V. Bal, and this was followed by a short note by Dr Panse dealing with the several points one has to bear in mind in undertaking comprehensive manurial trials in cotton which the Cotton Committee was planning to carry out. Professor R. H. Dastur gave a critical summary of the present position with regard to the investigations on the partial failure of cotton in the Punjab.

Quality and environment

Under cotton technology, Dr Nazir Ahmad gave a review of the position regarding the relation of the fibre properties to spinning performance of Indian cottons. Other papers in this section referred to the question of the quality of the cotton fibre as influenced by environmental conditions such as the place, the soil, rainfall, climate, etc.

The only contribution under cotton statistics was that of Dr Panse which related to the standardization of experimental technique in plant breeding. The chief papers of interest under cotton pests and diseases were those by Dr Uppal and others dealing with further progress made since the last conference with regard to breeding of strains resistant to wilt under controlled conditions and the genetics of wilt resistance.

The Conference was undoubtedly a great success in that it brought together several workers and gave them an opportunity to discuss problems of common interest. The importance of holding such conferences periodically among people working on different aspects of research in a particular crop cannot be overemphasized.

INDIAN SOCIETY OF GENETICS AND PLANT BREEDING

At the recent meeting of the Indian Science Congress at Benares, the Indian Society of Genetics and Plant Breeding was inaugurated. The following office-bearers were elected for 1941 :

President .	Rao Bahadur T. S. Venkatraman
Vice-Presidents	Dr W. Burns Mr K. Ramiah
Secretary .	Dr B. P. Pal
Treasurer .	Dr S. Ramanujam
Councillors .	Dr V. K. Badami Dr B. S. Kadam Dr J. S. Patel Dr T. S. Sabnis

The Society will issue a journal in which papers on genetics, plant breeding and cytology will be published.

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PLANT AND ANIMAL NUTRITION

Plants are the chief sources of nutrition and energy for human beings and animals. The stem, leaf, fruit and grain are either eaten direct or they may be first eaten by the animal and its milk or flesh afterwards consumed by human beings and animals. It therefore follows that it is the ability of plants to manufacture food and the right kind of it that is important in nutritional economy, said Rao Bahadur Viswanath in his presidential address to the Chemistry and Biology section of the National Academy of Sciences, which met at New Delhi in February.

It was not known till recently that the environmental conditions and particularly the nutritional conditions available to the plant are capable of exercising an influence on the metabolic processes in the plant leading to changes in its composition and nutritive value. Even if the gross composition of the plant is not found to vary, the first composition and the biological value of the constituents may be altered, leading to variation in the biological efficiency of the plant produce.

Rao Bahadur Viswanath referred to studies in plant and animal nutrition he had conducted fifteen years ago in collaboration with Lt.-Col. McCarrison and others, which show that :

1. Manuring influences the quality of the seed ;
2. Manuring influences the nutritional value of the crop ;
3. Plants require accessory food factors acting on plants as vitamins do on animals, and organic manures have as one of their functions the supply of the accessory factors ; and
4. In nature a cycle of accessory factors operates through soil-plant-animal, including human beings.

The findings were new and contrary to prevailing ideas. In the years that have passed more data have been obtained in India and abroad, which support the view that plants and animals need and respond to accessory factors, and that the role of organic matter and organic manures, particularly farmyard manure, is, besides exercising a direct influence on plant nutrition and metabolism, to help in the maintenance of the accessory-food-factor cycle in the cooperative existence of plants and animals. In its wild state, the growth and development of the plant is governed by the inexorable law of nature by which only the fittest can survive. With the interference of man, and the coming of the plant under the regime of cultivation, the natural balance is upset, and it then becomes necessary to minister carefully to the needs of the plant.

Agricultural scientists are engaged in breeding crops for high yields. Is it possible to combine high yield with high protein content ? There is no definite evidence on this point except that of the inverse relationship of nitrogen and yield. The desired combination of high yield and high protein content has therefore to be secured by manuring.

Large cultivated areas are poor in organic matter and other plant nutrients, and large sections of the people depend upon the food raised in these areas. This means dietary defects resulting from a low level of intake of certain foods which are also deficient in certain essential constituents, because they are raised

on deficient soils. Prevention of defects at the source of production is better than remedying them afterwards.

Intensive agriculture in the past twenty-five years has awakened Europe and America to the value of organic manures, and they now join India in the cry for the conservation and use of organic matter. The meaning is clear not only to Indian agriculture but to world agriculture.

What would you like to know?

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section will be reserved for replies to selected letters in cases where it seems that the information might be of general interest.

Q : Are there any simple measures to control the insect enemies of lac ?

A : The damage to lac crops can be appreciably reduced if the following measures are adopted.

1. Lac intended for use as brood lac should be cut as near to the swarming time as possible, never more than a week before, for optimum results.

2. In choosing lac for use as brood, healthy lac showing the minimum of parasite and predator attack should be selected.

3. Lac tied to the trees as brood should be removed as soon as the tree is sufficiently covered by the lac larvæ and in no case should it be allowed to remain on the trees for more than three weeks.

4. Natural infection (i.e. leaving a certain amount of brood lac called *chenti* on the tree to swarm *in situ*) should be abandoned particularly in October-November. Exception to this rule may be necessitated in certain localities, e.g. infection of *palas* (*Butea frondosa*) in Palamau is said to be more successful with natural infection than with artificial.

5. All lac cut from the trees not required for brood and all brood lac after use should be scraped from the sticks at once. This action alone destroys many of the larvæ and pupæ of the enemy insects and exposes others to climatic factors and to the attack of ants. Larvæ and pupæ of all insects which are easily visible may be crushed or killed by dropping in fire or hot water.

6. If possible, the manufacturers, soon after purchasing the stick lac, should convert it into *chauri* (seed lac). This eliminates the predators and parasites which after emerging as adults try to escape into the fields. Predators also breed on the stored lac.

7. In general, it is unwise to grow *kusmi* lac (lac grown on the *kusam* tree (*Schleichera trijuga*) or from *kusmi* seed on some other tree) predominantly *rangini* (lac not grown on the *kusam* tree or from *kusmi* seed), or *rangini* lac in areas which are predominantly *kusmi*, as the *kusmi* and *rangini* crops overlap and become a source of natural infection of predators and parasites.

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Q : Please let me know if there is anything which can be substituted for green fodder or silage in the ration of dairy cattle without loss of milk and the general condition of the animal.

A : The virtue of green fodder and silage which is, of course, a green plant in an ensilaged form, lies in their succulence, vitamin content and better availability of minerals, and therefore the inclusion of either green fodder or silage having all these properties is very essential in the dietary of milch cattle, particularly those which are carrying a calf.

Green fodder can be substituted for silage and *vice versa*, but there is no permanent substitute for either of them, unless the animals are sent out for liberal grazing on a good and abundant pasture land.

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Q : Owing to the variations in demand I have surplus milk left on my hands from time to time. I have also the problem of having to supply milk at short notice for parties and weddings. To meet these difficulties I propose to instal a refrigerator equipment with a view to keeping milk in cold storage for two or three days.

A : The keeping quality of milk depends upon the conditions under which it is obtained and the manner in which it is processed. Raw milk produced under hygienic conditions, cooled immediately and kept in cold storage at freezing point may keep for 48 hours, but pasteurized milk under similar conditions

may keep for about four days. You should consult the Livestock Expert of your province and, if necessary, the Imperial Dairy Expert at Bangalore on these points before embarking upon any large scheme for the installation of refrigerator equipment.

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Q : Please let me know :

(a) The sheep population of India.

(b) The annual production of wool in India.

(c) The quantity of wool exported annually to other countries.

(d) The average price of wool per maund in India over the past three years.

A : (*a*) 43,500,000.

(*b*) 87,000,000 lb.

(*c*) 55,416,000 lb. in 1938-39.

(*d*) Rs. 25-2-9 in 1936-37.
Rs. 37-12-0 in 1937-38.
Rs. 31-5-3 in 1938-39.

Q : I should like to know the process for preserving fowl eggs for a long period—say six months.

A : The preservation of fowl eggs is common in western countries and eggs are edible after a period of six months' storage. Preserved eggs are usually quite wholesome, but have sometimes a rather chalky flavour. However, it is necessary to point out that the climate of India is very different from that of western countries and no guarantee can be given in regard to the length of time that eggs will keep under Indian conditions.

Eggs for lime preservation are usually put in glazed earthenware containers. With one method, lime is mixed with water in order to form a creamy paste and the eggs are put in this and the whole of the material solidifies around the eggs. With this method 10 to 12 lb. of lime is added to water per 1,000 eggs. The liquid should come at least 1 in. above the top layer of eggs.

What's doing in All-India

BOMBAY

By B. S. Patel, N.D.D., N.D.A., C.D.A.D.
Principal, Agricultural College, Poona

GREAT damage was caused to fruit trees, especially the banana, the mango, the *chiku* and to coconut trees by the cyclone of 16 October 1940 at 75 miles per hour in the northern part of the Thana district. The banana plantations that suffered were mostly in the Bassein and Palghar area and the *chiku* plantations in the Dahanu, Gholvad and Umbergaon talukas. The Revenue Department is helping orchardists by granting *taccavi* loans, and the Agricultural Department is helping to secure fruit tree grafts and rendering technical help in replanting the damaged gardens. Some *chiku* trees have been successfully lifted up.

Training class for orchardists

A training class for orchardists was held by the Assistant Horticulturist to Government in November, 1940, for a week at Nimbhora under the auspices of the Taluka Development Association, Raver, East Khandesh. In the morning, the students who numbered 106, were taken to their own gardens in the neighbouring villages and scientific methods of propagation, budding, grafting, manuring, pruning, control of pests and diseases and preparation of bone manure and compost were demonstrated. Fruit preservation, bottling of juice and banana drying were also shown. The students evinced keen interest in the class and it is felt that such classes were very helpful to orchardists in the rural areas.

Intensive bunding class

The demand for admission to the *bunding* class, first started in 1938, has increased year after year. In the first class 45 students were selected, in the second class 20, and this year there were two classes of 24 students each. The last class for the current year closed on 15 March 1941.

The students selected are either agriculturists or landowners who have passed the vernacular final examination. In each class there were some students who had studied up to the English fifth standard, some non-matriculates, a few matriculates and a few with collegiate education.

The students worked from 8 to 11-30 a.m. and from 2-30 to 5-30 p.m. They usually worked in four batches, each batch independently under a *kamgar* and all of them in charge of a graduate assistant.

The work consisted of a number of practical field exercises in order to give them a thorough idea of the use of survey instruments and methods of work. They were taught the use of the following instruments :—Chain, Cross-staff prismatic compass, dumpy level, and farmer's level. The field exercises mainly consisted of survey layout of field by chain and cross-staff, fixing boundary and position of objects, survey by compass, taking levels, determining contours and use of plane table. One hour in the afternoon was devoted for explanation and sufficient notes on the above exercises were given to make the work clear. The rest of the time in the afternoon was utilized in plotting the work maintained in their field books.

The technique of *bunding* and waste weirs was fully explained and the actual layout of field *bunds* and waste weirs was carried out. Slides and epidiascope plates referring to erosion and *bunding* were shown. They were also taught how to read village maps and toposheets.

The students were taken round on a ten-day tour to see important schemes and

problems. During the tour the students maintained notes of useful information given.

Besides the normal training in *bunding* they were given physical training twice a week, scout games, first-aid, lectures illustrated by magic lantern slides on general and hygiene topics. Advantage was taken of Sundays and holidays and the students were taken round to places of interest like the Fruit Research Station and Apiary, the College farm, the College dairy, the Central poultry farm, the Veterinary hospital, the Deccan Paper Mills, Karla Caves, Reay Museum, Pocha's nursery and seed stores, and the electrical laboratory of the Engineering College.

HYDERABAD

By Mirza Mohiuddin Baig, B.A.

Personal Assistant to the Director of Agriculture, Hyderabad, Deccan

In view of the economic depression, H. E. H. the Nizam has been pleased to sanction the following concessions in the collection of land revenue from agriculturists :

(1) remission of 3 as. in the rupee on lands under *abi** cultivation in all the talukas of Adilabad and Karimnagar districts and in the talukas of Warangal, Mulug and Pakhal in Warangal district and of 2 as. in the rupee on lands under *abi* cultivation in the remaining talukas of Warangal district and also in all the talukas of Medak, Gulbarga and Aurangabad divisions ;

(2) remission of 2 as. in the rupee on the sugarcane crop under first *abi* cultivation, in view of the fall in the price of *gur* ; and

(3) remission of 10 as. 8 pies in the rupee in *khalsa*† and of 3 as. in the rupee in *jagirs*‡ on lands under well-irrigation, as last year.

The concessional rates will apply to *jagirs*, *samasthans*‡ and *paigahs*‡ also. The Subedars and First Taluqdars have been asked to see to it that the agriculturists receive these concessions granted by the Government.

Horticultural and Poultry Show

The first Hyderabad Horticultural and Poultry Show was held in 1931 by the Department of Agriculture to find out the existing position of the local horticultural and poultry industries. The ninth show was held this year on the 16th, 17th and 18th January. The main object for continuing the show is to create a keen competitive interest in these industries. It has encouraged and helped the people of the state to raise good poultry and to grow more and better fruits, vegetables and flowers.

His Highness the Prince of Berar, Walashan Nawab Azam Jah Bahadur, was the Patron-in-chief of the Show. The Rt. Hon. Sir Akbar Hyder Nawaz Jung Bahadur and Sir Theodore J. Tasker were the Patron and the Vice-Patron respectively. Mr Nizamuddin Hyder was the President of the Executive Committee and Mr Mirza Mohiuddin Baig the General Secretary of the Show.

There were 139 entries and 957 exhibits in the horticultural section as against 45 entries and 349 exhibits in the first show of 1931. The quality of the exhibits in fruits and vegetables was excellent.

In the poultry section there were 136 entries and 644 exhibits as against only 96 birds in 1931. The birds in the last show were of pure breeds and true representatives of their classes. The judges took some time to select the prize birds.

Large crowds visited the show during the three days it was on.

* The autumn harvest of rice.

† Lands which are under direct management of the Government, and the revenue from which goes to the Government exchequer. They cover an area of about 50,000 sq. miles, with an assessed revenue of Rs. 3,20,00,000.

‡ Lands the revenue of which has been wholly or partly assigned for some special purpose.

Poultry section

The Poultry Section was open to the birds reared and bred in Hyderabad State only, but provided a class for imported birds also. Two classes were specially provided for bonafide cultivators' White Leghorns and Rhode Island Reds. The remaining 19 classes consisted of Aseels (Indian game fowl), White Leghorns, Rhode Island Reds, Black Minorcas, Light Sussex, Australorps, Orpingtons, Barred Plymouth Rocks, ducks, turkeys, guineafowls, eggs and the birds belonging to Government and Municipal institutions. There were 644 exhibits in all.

The strongest class exhibited in the Show was the Aseel, consisting of 100 birds. The next class of importance, consisting of 85 exhibits, was that of White Leghorns. The Rhode Island Reds stood third. The best bird in the Show represented the White Leghorn class. There were 151 prizes in the shape of cups, cash and certificates awarded to the exhibits of merit.

Horticultural section

This section also was open only to the exhibits raised in the state, except for classes which were exclusively meant for imported exhibits, e.g. fruits, vegetables and ornamental plants. Private gardens partly maintained by the Government within the cities of Hyderabad, Secunderabad and the Cantonment area also competed. The remaining 15 classes consisted of foliage plants, perennial and annual flowers in pots, cut flowers, collections of ornamental plants and vegetables from private individuals and Government institutions, collections of fruits, vegetables, etc.

The majority of exhibits of quality was in vegetables, fruits, cut flowers and foliage. The vegetable class had 346 exhibits, the largest number. There were 290 exhibits under fruits. The cut flowers class stood third with 158 exhibits.

The number of prizes awarded to the exhibits of merit and the competing gardens was 217 in the shape of cups, cash and certificates.

Increased yields by dry farming

The Dry Farming Research Station at Raichur has discovered certain cultural operations which bid fair to help farmers to grow a successful crop even in years of scanty rainfall.

Of the cultural experiments carried out, the *bunding* of land has made possible not only a normal crop under adverse conditions, but an actual increase in the yield of produce. In cotton alone an increased yield of 16 per cent on an average has been observed. *Bunding*, together with certain tillage operations, shows an increase in yield almost 69 per cent over that of the crop reared under the present local methods.

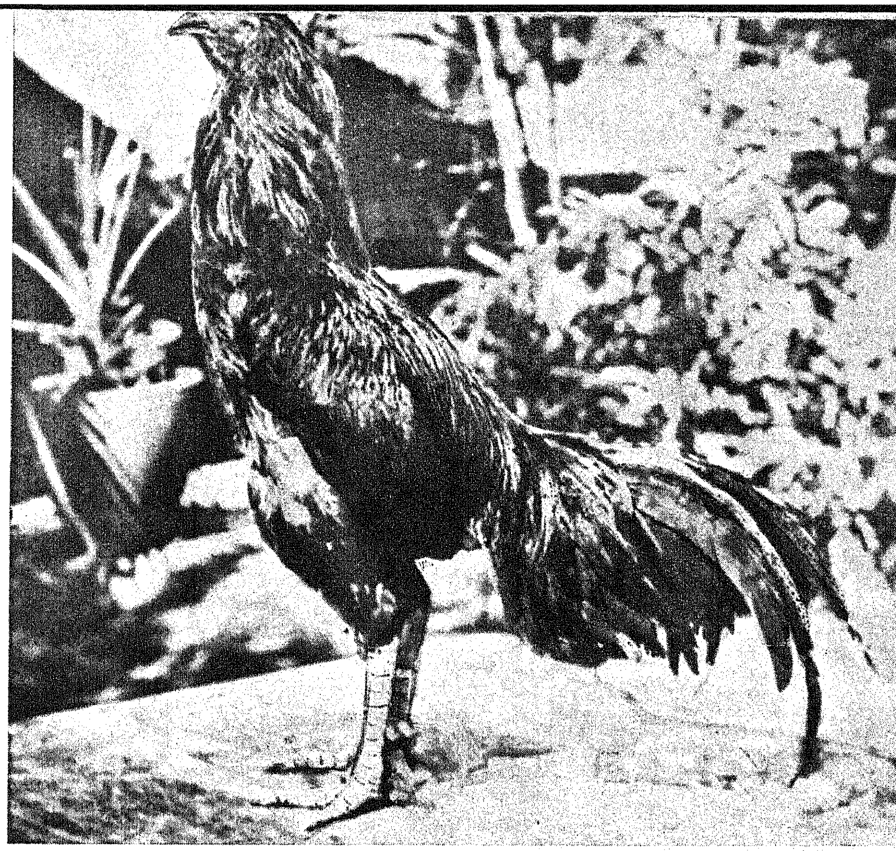
The station also obtained very promising results from the experiments carried out on the fallowing of land. Along with an improved strain of seeds, fallowing of land has given double yields. *Jowar* alone yielded 131·5 per cent more grain and 120·8 per cent more straw.

Improvement of Oomra cotton

The districts of Aurangabad and Parbhani and parts of Bhir, Osmanabad, Karimnagar and Adilabad districts grow a variety of cotton commonly known as Oomra, on an area of about 20 lakhs of acres. Some 30 years ago, this tract used to grow the fine staple variety Gaorani. After that some short-staple types from the Central Provinces and Bombay got in. The produce has thus become mixed. Consequently, the tract has lost its reputation for fine staple, and the growers are getting lower prices for their produce. To improve these conditions, the Agricultural Department submitted a scheme to the Indian Central Cotton Committee in August 1940. The object is to evolve an improved variety of Oomra cotton which will give finer staple and yield at least as much as the mixture grown at present. The Committee approved of the scheme for a period of five years. The work will be carried out at Parbhani. The Indian Central Cotton Committee will contribute about Rs. 70,000 towards the cost of the scheme and the Hyderabad Government will spend about H. S. Rs. 20,000.

Extra 2·5 lakhs for cotton growers

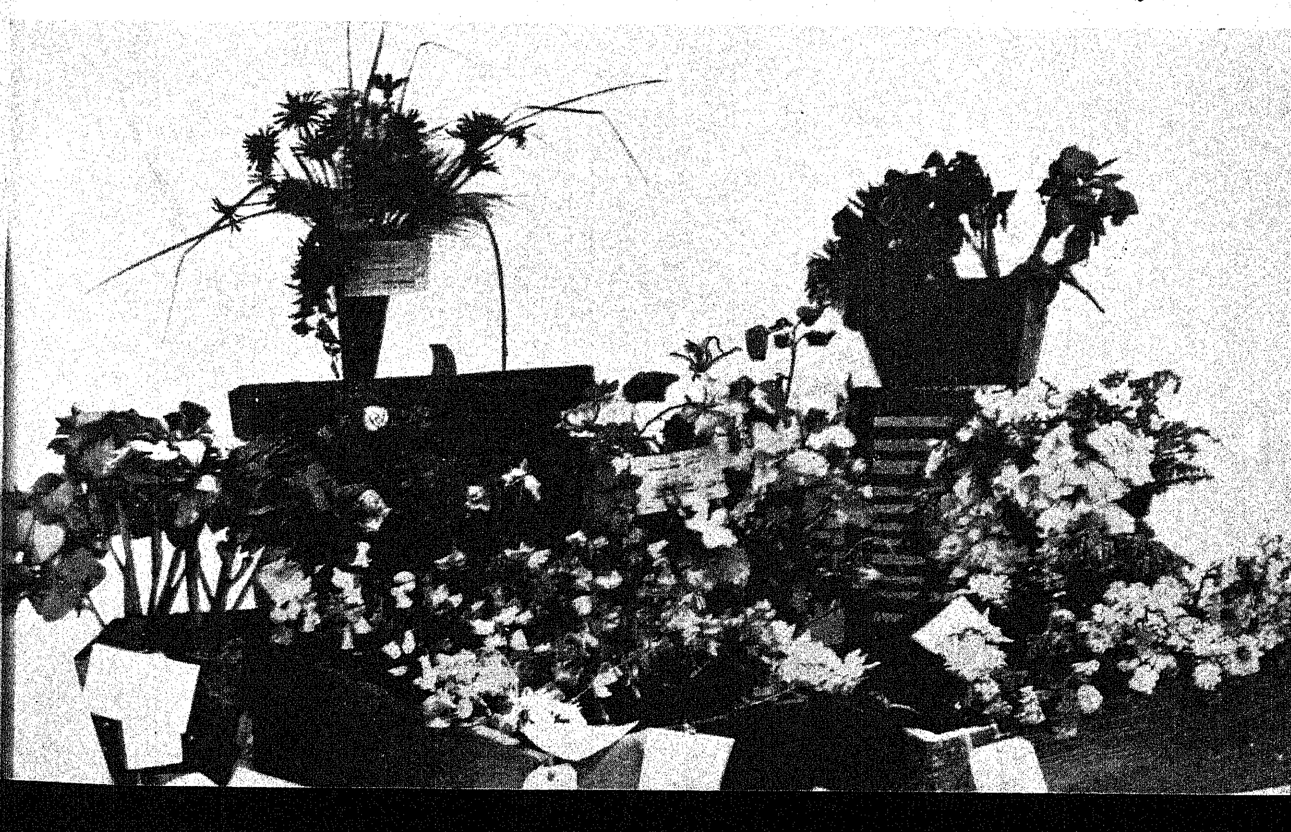
The cotton growers of the Raichur district



Best Aseel bird in the Horticultural and Poultry Show, Hyderabad-Deccan

[PLATE

Some prize-winning exhibits in the cut flowers section, Hyderabad Horticultural and Poultry Show



Some prize-winning exhibits in the vegetable and fruit sections (Hyderabad-Deccan).

earned an additional profit of Rs. 2·5 lakhs over and above what they normally got, as a result of the Jayawant cotton seed distribution scheme which was launched some years ago. Four and a half lakh pounds of Jayawant cotton seed, an improved strain that had proved on extensive experimentation to be best suited for large tracts of the district, were distributed by the Agricultural Department. There are at present 72,000 acres under this improved cotton seed. This scheme is financed partly by the Indian Central Cotton Committee and partly by H. E. H. the Nizam's Government.

Power alcohol factory

Steps are being taken by the Government to help in supplying locally 25 per cent of the motor fuel consumed in these Dominions. This has been rendered possible by the profitable utilization of the huge quantity of molasses obtainable as a by-product at the Bodhan Sugar Factory, which started work three years ago with an authorized and paid-up capital of Rs. 35 lakhs. The factory is equipped with a Mirrles Watson double sulphitation plant, with a maximum crushing capacity of 1,500 tons of sugarcane per day.

State banking

In view of the rapid agricultural and industrial development of the state giving rise to new problems of banking and finance, Government have now decided to establish a state bank. Government have also decided to establish a land mortgage bank to function as an adjunct to the state bank for the payment of the conciliated debts of the agriculturists. The agricultural and industrial development of these Dominions has now reached a point where borrowing facilities become essential. The agricultural indebtedness in the state is estimated, as the result of a detailed enquiry, to approximate to Rs. 100 crores. It is obvious that the existing credit facilities cannot by themselves redeem the position the only remedy for which lies in the provision by the state of opportunities for long-term borrowing. This will be possible through the agency of the state bank. The Government have also decided to establish rural banks in headquarters towns on cooperative basis. The sphere of operation of each rural bank will embrace ten to twelve neighbouring villages, and the local well-to-do farmers, including *sahukars* (moneylenders) will be persuaded to participate in its management. They will be offered special facilities for investment. With a view to facilitating the inflow of deposits in these banks, Government have decided, as an experimental measure for five years, to guarantee 4 per cent interest on deposits in these banks up to Rs. 1 lakh in each of the four *subas* of the Dominions (totalling Rs. 4 lakhs in all).

Modernization of villages

Neat and clean villages, surrounded by green paddy and sugarcane fields, bear testimony to the rural reconstruction activities of the state. They have been rendered much more easily accessible and therefore more susceptible to modernizing influences.

In Nizamabad district 222 villages out of a total of 519 have been provided with roads at a cost of Rs. 2,64,548. The problem of pure water supply in rural areas is also being tackled, and 69 villages have already been provided with *pucca* wells costing Rs. 45,201.

In order to inculcate the habits of cleanliness and good health, the villagers are being given practical lessons in hygiene and sanitation. Pits and small pools in and around the villages, which used to serve as breeding places for malaria-carrying mosquitoes, are being systematically filled, and refuse which used to be accumulated in the vicinity of huts is now stored in pits dug outside the villages. *Pucca* gutters have been constructed on either side of village lanes for dirty water to drain off. This has considerably toned up the general health of the rural population.

Nor has the recreational side of village life been ignored. Public parks and playgrounds have been provided practically in every village. *Chowdies* (village headquarters) which serve as meeting places of villagers have been constructed in 177 villages at a cost of Rs. 75,288. In these *chowdies* are held village panchayats or conferences and social gatherings on special occasions.

Like other districts of the Dominions, Aurangabad is also forging ahead with rural welfare activities. The question of pure and hygienic water supply is receiving particular attention. Each village is being provided with two draw-wells. So far 40 such wells have been provided at a cost of Rs. 12,015, and 38 old wells have been remodelled, involving an expenditure of Rs. 11,794.

Next in importance to water supply is the provision of approach, i.e. roads, to villages. Each year two zones in each division are selected for concentration of this work. In 1938-39, Bhokardan and Kannad talukas were taken up and the talukas of Ambad and Aurangabad were selected the following year. The total amount spent on roads in these talukas is Rs. 26,646.

Improvements in other directions include the provision of open-air playgrounds at a number of places in the district, and construction of *chowdies* and bazars and school buildings.

For pupils who drop off after the primary stage a supplementary class, with special provision for training in local crafts and agriculture, has been instituted by the Department of Education as an experimental measure in four villages in Warangal.

Popularity of fruit-growing

The Department of Agriculture has experimental gardens at Himayatsagar, Parbhani, Raichur, Warangal, Sangareddi, Rudrur and Aurangabad. The main work at these gardens at present consists of experiments with different varieties of fruits. Studies of manurial irrigation and cultural practices are also being made in a general way. The scheme of the Imperial Council of Agricultural Research for research on grapes at Aurangabad and on custard-apples at Sangareddi is to be started shortly. Propagation work is also being done at these gardens, and supplies of plants, etc. are made to the public from there.

Demonstrations of horticultural practices are arranged at the annual farm demonstrations and at important *jatras, urses* (religious fairs), etc. Leaflets on horticultural practices printed in local languages are distributed to the public. The horticultural and poultry show is an annual function at Hyderabad. It has become very popular and has helped a great deal in increasing the interest of the public in horticulture and poultry.

The gardeners' training class at Himayatsagar has proved very useful. It is a two-years' course of practical training in gardening, as well as in the preservation of fruits and manufacture of fruit jelly, etc. Ten students are admitted every year, and a stipend of Rs. 10 per month is given to each of them. Thirty-three students have so far passed out after successfully completing the full course. Some of them are working in their gardens while others have secured employment as gardeners in Government Departments or with private garden owners.

As definite results become available from the departmental experiments, they are communicated to the public for their benefit. Some improved varieties of the following kinds of fruits have so far been introduced in private gardens in the state: mango, guava, grapes, papaya, pineapple, grape-fruit, sapodilla, coconut, figs, bananas, etc.

The number of plants supplied from the departmental nurseries to the public in 1934 was 398 and in 1940 was 44,837. This is in addition to the thousands of plants obtained by the public from outside the state and purchased from many private nurseries which have come into existence in recent years.

The area under fruit and vegetables in the state expanded from 497,117 acres in 1932-33 to 682,126 in 1936-37. Figures of area of fruits, separate from vegetables, are not available in the report of the Statistics Department. The Marketing Report shows that the area under mango, citrus, guava and banana expanded from 2,908 acres in 1933 to 32,508 acres in 1937.

A substantial decrease has taken place in the imports of some fruits. For instance, the import of citrus fell from 12,000 md. in 1934 to 7,000 md. in 1938, and the import of bananas fell from 55,000 md. in 1934 to 24,000 md. in 1938.

THE PUNJAB

By Malik Amanat Khan, B.Sc. (Edin.), P.A.S. (Class I)
Associate Professor of Agriculture, Punjab Agricultural College, Lyallpur

The last three months of 1940 were practically rainless, with the result that famine conditions in the south-east which improved some time back owing to the advent of well-distributed and timely monsoon rains, reappeared in some parts of the Hissar district. The relief given by the Punjab Government to the famine-stricken people has been unprecedented. Never before in the history of this province have relief and health measures been organized on such an elaborate scale and never have they been more effective in safeguarding the health and lives of the famine-stricken. Epidemics, which so frequently develop during famines, have been warded off, and alarming death rates, which accompanied similar visitations in the past, have been reduced by about 50 per cent. The cost to the province of all these measures has been very great indeed. In the district of Hissar alone over one crore of rupees has been distributed in direct relief. Over Rs. 40 lakhs have been advanced as *taccavi*, Rs. 16 lakhs of revenue and *abiana* (irrigation charges) have been remitted and Rs. 48 lakhs of land revenue have been suspended. In all the cost of this relief, direct and indirect, exceeds Rs. 2 crores. This does not include the cost of extra staff posted to this district.

Owing to lack of rains in October, November and December, relief is again being provided in 214 villages of the Hissar district to nearly 25,000 people. A considerably augmented health staff is regularly touring the affected areas, and germinated grain, which has proved effective in counteracting deficiency diseases, is being issued to over 160,000 persons.

Crop prospects

The period was unfavourable for crop growth owing to continued drought. As the winter advanced, temperature did not fall in the normal way. October was hot. This adversely affected cottons which were then passing through a critical time of fructification. However, *desi* cotton on the whole did well. American cotton, on the other hand, suffered from bad opening of bolls. The extent of immature opening, however, was not serious, though in certain localities it caused some hardship to the small cultivators. The causes of bad opening have not yet been elucidated, but it appears that restriction of area under the crop, copious irrigation and delayed sowings may act as palliative measures.

Crushing of sugarcane has started and is in full swing, but the price of *gur* prevailing this year is lower than that of last year. Wherever *rabi* sowings in the *barani* (rain-fed) areas were done in the earlier part of the season, the crop suffered from drought and the attack of white ants became very severe. Rain in such localities was badly needed, and was welcome when it came.

The canal water supply was also insufficient and long canal closures at sowing time further delayed sowing of the wheat crop. Consequently, some 30 to 40 per cent of the area under wheat was sown late. Late sowing of wheat generally affects the yield adversely, and in years like the present when perforce a sizable proportion of wheat area had to be sown late, great need is always felt for a wheat type which under late sowings may give better account of itself than the existing varieties. Up to now, C 591 was being recommended for this purpose. Now we have a new type, viz. C 228 which has consistently been giving higher yields than our present improved types for many years at the departmental farms. It is hoped to get this wheat type officially approved in the near future and to give it out to the farmers.

It has been found that where sowings of wheat have to be made late, it is better to sow it in dry land and irrigate it immediately afterwards, in preference to the usual zemindari method of first irrigating the field and then sowing the wheat crop when it has come into *wattar* (fit for cultivation). The dry-sown wheat gets a start of about ten days in germination over the crop sown in *wattar* and

it makes all the difference between a poor and a high yield. An additional yield of 2 to 2½ md. per acre of grain is obtained from dry sowing. This method is, however, not recommended for stiff and *kalrathi* (alkaline) lands.

Berseem trials

Large quantities of berseem seed are annually imported into the Punjab from the N.-W. F. Province for sowing. It was observed during 1936-37 that the crop raised from the local seed gave one cutting less towards the end of the season and finished off earlier than the crop obtained from the Peshawar seed. In order to confirm this, an experiment was conducted in 1937-38 and repeated in 1938-39. As a result of these experiments it was found that the crop raised from Peshawar seed gave less fodder in the beginning of the season, but later on it gave heavier cuttings and kept green longer. But the total yield was practically the same in both cases. The superiority of one to the other generally depends upon the nature of the weather during May and June. If the weather is hot, the Peshawar variety yields less and *vice versa*.

For seed production, the indigenous type is decidedly better than the Peshawar variety, because the latter being a late ripener suffers from the hot and dry winds in May and June when seed is being formed.

Raya L18

Raya L18, which has a tall and vigorous growth, very broad leaves, profuse side branching, medium maturity and blackish seeds of fairly bold size, is a selection from the mixed types of Raya commonly grown in some parts of the province made by the Oil-seeds Botanist, Lyallpur. This variety can grow successfully under varied conditions of climate, soil, and moisture, and is a very useful variety of oleiferous brassica crops for cultivation throughout the province during the *rabi* season. The chief merits of this type are:

1. *High yield of seed.*—On the average of a large number of tests carried out at departmental farms during the past few years under both irrigated and *barani* conditions, this type yielded 15 maunds 20 seers of seed per acre as against 10 maunds 2 seers obtained from the local strains of *sarson*. In the trials carried out at some private farms also, Raya L18 has given similarly enhanced yields. The maximum yield in some cases under most favourable conditions was as high as 30 md. per acre which is undoubtedly a record yield for any form of oleiferous brassica crops grown in the Punjab.

2. *Hardiness.*—Raya L18 is capable of withstanding drought and frost successfully and can also resist the attack of aphis (*tela*) which is a serious pest of ordinary *sarson* (*Brassica campestris*). Owing to its well-developed and most vigorous root system, it has proved to be suited to both *barani* and irrigated conditions.

3. *Self-fertility.*—The plants of Raya L18 are, unlike those of *toria* (*Brassica napus*) and brown *sarson*, self-fertile by nature; hence their seeds can be kept pure from generation to generation without any fear of deterioration through natural crossing. This also ensures the supply of such seed from year to year as it is true to type and is free from admixture of seeds of allied forms of brassica.

4. *High fodder yield.*—The plants of this variety being very tall, leafy and quick-growing, it yields a high tonnage of green, succulent fodder as well. Hence, in those parts where other fodders are scarce, it can be grown successfully as a fodder crop also.

Poultry

The trials with the indigenous breeds fowls for table quality continue at the Gurdaspur poultry station. As an indication of what can be achieved merely by selecting outstanding subjects for breeding purposes, the following figures from the growth records of young stock of two generations are given:

Breed	Live weight in oz. at 24 weeks	
	This year	Last year
Asil (Indian game fowl) . .	55·59	42·25
Chittagong	51·12	41·10
Improved Punjab (Brown) . .	48·13	36·49
Desi (Mongrel fowls) . . .	45·62	39·00

The fruit soldier !

Stall of Parkarabad orchards, Shiekhupura.

The great gun !

Stall of Diwana Fruit Farm, Shiekhupura.

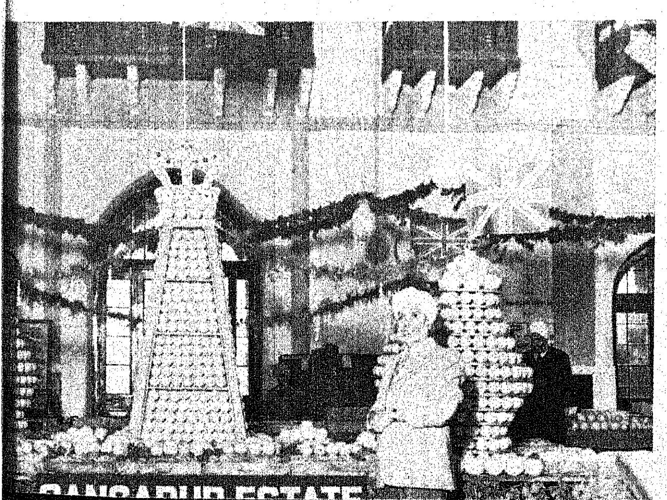
THE PUNJAB CITRUS FRUIT SHOW

[PLATE 8

' A fortress of health '

Stall put up by the Gangapur estate was awarded the 1st provincial prize for the best decorated stall in the show.

Presenting fruit products of various manufacturers to the judges for tasting.



Prof. Koch's visit to Mukteswar in 1897

Standing (Left to Right): Dr J. W. W. Stephens, Capt. F. S. H. Baldrey (afterwards Supdt., Civil Veterinary Department, C. P. & Berar), Capt. H. T. Pease (afterwards Inspector-General, Civil Veterinary Department), W. R. Hagger, Assistant to the Inspector-General, Civil Veterinary Department (formerly Principal, Ajmer Veterinary School) and Capt. G. H. Evans (afterwards Supdt., Civil Veterinary Department, Burma).

Sitting (Left to Right): Dr A. Lingard, Prof. R. Koch, Prof. R. Pfeiffer and Capt. F. Raymond (Principal, Bengal Veterinary College).

PLATE 81]

No further incidence of Doyle's (Ranikhet) disease has been reported during the last six months, and it may be considered that the third cycle has been completed as far as the Punjab is concerned.

Citrus Fruit Show

The Punjab University Hall, Lahore, was a picturesque scene from 6 to 10 January when the Punjab Annual Provincial Citrus Fruit Show was held there. The exhibitors included high-court judges, retired Government servants and the unknown, unsung ryot. The stall holders made great efforts to arrest the attention of visitors. The skill displayed in arranging fruits in most attractive designs evoked tributes from all. Some of the catching slogans were: 'Give 'em juice to crush Hitler' Send the troops Punjab oranges and we will win the war; 'Fruit—the "Great Gun" to protect National Health'. As some one aptly remarked, they showed the war-mindedness of the Punjab.

The Hon'ble Ch. Sir Shahab-ud-Din, Speaker of the Punjab Assembly and President of the Punjab Fruit Development Board, referred to the backwardness of the fruit industry in the Punjab in his presidential address delivered to the fruit-growers at the annual general meeting of the Board on 8 January. He said that although conditions for fruit development were favourable in the Punjab, the province had at present hardly one acre of garden for 400 of the population as against one acre for seven in Palestine and about three in California. Further, the Punjab had only an acre and a half under fruits for every thousand acres of culturable areas as against 250 acres in California.

The Hon'ble R. B. Ch. Sir Chhotu Ram, Development Minister, who gave away the prizes, referred to five main events since the last annual fruit show which, the Development Minister believed, hold a rich promise for the future of the industry. These events he enumerated as follows:

1. By persistent efforts the Joint Fruit Development Board had succeeded in inducing the Irrigation Department to agree to the supply of canal water for fruit gardens on a scale twice that permitted for ordinary field crops. Supply on this scale had been promised to ½ per cent of the total area commanded by all canals in the province. This would enable 97,000 acres of additional land to be put under fruit trees.

2. His Highness the Maharaja of Mandi had kindly made over for management and maintenance to the Punjab Public Works Department that section of the Kulu road which fell within the jurisdiction of his state. This meant the elimination of all tendencies for a monopoly of transport facilities and of those prohibitive tolls which threatened to stifle the fruit trade between the Kulu Valley and the plains. A budget provision of Rs. 7 lakhs had been made for widening, properly consolidating and tarring the road between Ghatta-Baij Nath and Mandi.

3. The Joint Fruit Development Board had succeeded in overcoming the proverbial conservatism and close-fistedness of the Finance Department. Only two days ago, declared Sir Chhotu Ram, the Hon'ble Sir Manohar Lal announced his intention to brush aside the usual obstructive tactics of his Department in the interest of the fruit-growing industry.

4. The Imperial Council of Agricultural Research had decided to engage central staff for work connected with fruit and vegetable products. The Council was likely to start a central institute for the purpose. The outbreak of war and consequent demand for large quantities of canned vegetables and fruits would give a fillip to this new venture and since the Punjab was admittedly the pioneer province in such activities, the fruit-growers and fruit preservers of our province were bound to gain immensely.

5. Horticulture had been recognized by the Punjab University as a major subject for the degree of B.Sc. in agriculture and also as a suitable subject for the degree of M.Sc. in agriculture.

The Month's Clip

RECENT REORGANIZATION AND RESEARCH IN THE MALAYAN PINEAPPLE CANNING INDUSTRY*

By W. J. B. Johnson

Canning Officer, S. S. and F. M. S.

THE steady growth during the past 20 years of the Malayan pineapple canning industry to a position of major importance amongst the agricultural exports of this country has necessitated considerable developments both in the organization of the industry and in technical research.

In 1930 and 1931 a Conference, appointed by H. E. the Governor and High Commissioner, was held to investigate the conditions then existing in the industry, a report of which was published in August, 1931. Since that date numerous issues of this *Journal* and Annual Reports have recorded changes in the organization of the industry and the appointment of a Canning Officer with the subsequent opening of a Canning Research Station and Demonstration Factory in the State of Johore. The present article records the progress made in organization and research during the past two years.

Central Board of Pineapple Packers

During 1937 and the early part of 1938 the industry passed through the worst slump in its history, the selling price of a case of 48 1½ lb. squat cans of standard quality falling as low as $2·40. These depressed conditions were brought about by the competition, which has increased enormously during the past few years in the canned fruit trade, coupled with lack of organization and cooperation in the Malayan pineapple industry. On many occasions in the past both packers and growers have, in times of difficulty, attempted to organize themselves in order to safeguard their several interests; but such efforts always failed to achieve the results aimed at owing to lack of sustained support for any course of action agreed upon. Early in 1938 there were many discussions among the packers, who in May of that year petitioned Government to come to their assistance. The packers put forward proposals for consideration in which they frankly admitted that past experience indicated that some measure of control by Government and the enactment of legislation to effect this would be required to bring about effective organization and provide the stability and continuity of effort which they considered necessary to enable the depressed conditions to be remedied and to place the industry in a position to function successfully in the future.

The scheme put forward was considered to be generally satisfactory and likely to achieve the objects sought. After certain amendments and additions it was accepted by the three Malayan Administrations which are at present concerned with the canned pineapple industry, viz. the Straits Settlements, Selangor and Johore. The necessary legislation was enacted, and the inaugural meeting of the Central Board of Pineapple Packers, Malaya, was held on 6 February, 1939.

The scheme provides *inter alia*:

(*a*) Legal power to specify one or more Associations as being representative of the canning branch of the pineapple industry.

(*b*) That the Registrar under the Pineapple Industry Ordinance and Enactments may refuse to register a pineapple factory (1) if he is of the opinion that there already exists a sufficient number of pineapple factories to satisfy the requirements of the Malayan trade and/or (2) if the applicant for such registration

* Reproduced from *The Malayan Agricultural Journal*, Vol. XXVIII, No. 10, October, 1940.

is not a member of a representative Association as specified in (*a*) above.

(*c*) For the establishment of such a representative Association, designated The Central Board of Pineapple Packers, Malaya, and composed of pineapple canners, each member being allotted a number of shares, the number being determined proportionately to the output of the factory or factories owned or otherwise controlled by such member.

(*d*) That sales of canned pineapples by members shall be to the Central Board only, at a price to be fixed by that Association from time to time. The Association, however, has power to authorize sale by one member to another member.

(*e*) For Government representation at the meetings of the Central Board with very definite powers of control.

(*f*) For the attendance of representatives of the Singapore Chamber of Commerce and of the pineapple growers at all General Meetings of the Association.

(*g*) For the price to be paid by members for fresh fruits. This price is varied in accordance with a sliding scale and at any given time is fixed by calculation based, on the one side, upon an agreed basic minimum price for a case of canned pineapple (G.A.Q. 1½ lb. cubes) and an agreed rate of allowance for the fruit contents of such a case and, on the other side, upon the market price ruling at the time for a case of G. A. Q. 1½ lb. cubes.

(*h*) That the Association shall adopt within two years of the date of inauguration the Malayan Mark or any other scheme introduced by the Governments of Malaya concerned with the grading of pineapple products.

The sliding scale originally adopted for the price to be paid for fresh fruits proved very satisfactory for fruit of average size and quality, but it did not specify the prices to be paid for fruit of quality and size above or below the average, and it was found necessary to draft an additional schedule of rules for calculating the prices to be paid for all types of fruit. For the purpose of these calculations it was agreed that the fruit should be divided into four classes according to weight and two classes according to degree of ripeness, namely: 'less than half ripe' and 'at least half ripe,' and the prices calculated on the basis of the figures given in the following table:

Class of fruit	Total percentage recovery	Average weight of 100 fruit lb	No. of cans filled by 100 fruit	Percentage of golden pack in fruit 'at least half ripe'
Under 1½ lb. .	17	125	28	Nil.
1½ lb. to 2½ lb.	20	200	53	30
2½ lb. to 3½ lb.	20	300	80	40
Over 3½ lb. .	20	400	107	60

NOTE.—It pays to grow *big* fruits for canning purposes.

The premium to be paid to growers for golden fruit, calculated on the figures given above, is one half the difference between the selling price of golden and standard grades of the canned article. It was also agreed that factories in Kranji, Singapore, should pay an additional 10 cents per fruit content of one case and those in the municipal area of Singapore an additional 15 cents to cover further transport costs and export duty on fresh pines from Johore. By these rules the growers share very fairly with the canners any fluctuations in the market price of canned pineapple.

Since its inauguration the Central Board has operated smoothly and efficiently. The selling price of a case of canned pineapple was raised from \$2·40 to \$3·10 on the formation of the Board; and this price was subsequently steadily raised to \$3·35 per case before the outbreak of war. The price now stands at \$4·85, the final increase being due almost entirely to the increased costs of the raw materials. The Board has made possible the control of production and marketing and has placed the industry in a more stable financial condition and in a more manageable state, at the same time safeguarding the interests of the growers.

Growers' Association

After the formation of the Central Board the growers felt the need of some representative body to safeguard their interests. After much discussion, the Singapore and Johore Pineapple Planters' Association was formed with an office in Johore Bahru, with the

object of safeguarding the interests of the growers and of improving conditions for them. The Association was given official sanction and two Government representatives attend all meetings. The Association has already proved itself useful by keeping a watch on the prices paid for fresh fruit at factories, and during the recent strikes in the factories by allocating the reduced quota of fruit to the growers.

Standardization of can sizes

Regulations governing the use of the ten standard can sizes agreed to by the canners came into force in March, 1938, and apart from the initial troubles experienced by the canners during the change over from non-standard to standard sizes the regulations have worked satisfactorily, and there have only been very few instances where cans have been found to vary from the dimensions specified by more than the tolerance allowed.

The ten sizes included in the regulations were made to conform in diameter to United Kingdom and American can sizes, while the heights were chosen to suit the canners' requirements, governed largely by the size of the sheets of tinplate available in Malaya. This partial standardization was carried through as it was considered to be the first step towards full standardization in which all sizes used in Malaya would be exactly similar to United Kingdom and American sizes.

The change over to full standardization in one move would not have been practicable, firstly as many of the canners were at first opposed to any form of standardization, and secondly as it would have upset the existing markets for many of the non-standard cans which at the time were considerable.

This partial standardization has proved a success, it has greatly simplified the packing and has helped to stabilize the market and standardize the pack. It is now generally approved by the industry and several of the large canners have expressed the opinion that they would now welcome a change over to full standardization, limiting the number of sizes to about five and all corresponding exactly to United Kingdom and American sizes, with the exception of the $1\frac{1}{2}$ lb. Squat size, which is a can peculiar to this industry and for which there is no United Kingdom or American equivalent.

Malayan mark grading scheme

The regulations for the Malayan Mark Grading and Marking Scheme came into force about the middle of 1938; they were introduced as a voluntary scheme and up to date none of the canners have started to pack under the scheme.

Considerable work has been carried out at the Canning Research Station to draw up exact working definitions of the various factors of quality for marking and grading in order to standardize the examination of Malayan Mark samples, and to eliminate the human element as much as possible. Numerous samples were examined on Malayan Mark lines in order to perfect the technique of examination. Samples are now being taken every month from all operating factories for examination on Malayan Mark lines and reports on the samples are submitted to the canners with a view to making them familiar with the working of the scheme.

New canning research station

During the latter half of 1937 the Canning Officer transferred his office and laboratory equipment from Kuala Lumpur to a temporary building in Johore Bahru, in order that he might be near at hand during the erection of the buildings for the new canning research station at the 5th Mile, Scudai Road, Johore Bahru. The buildings for the station were completed before the end of 1937 and the office and laboratory were equipped and research work resumed, but owing to the international situation there was some delay in the delivery of the machinery for the demonstration factory, and it was not until early in 1939 that all the machinery was finally installed and the plant working.

The station consists of two sections, one containing a laboratory and small-scale canning plant, where canned foods can be examined and tests made on the raw products of canning such as tinplate and sugar, also where research work can be carried out to improve processes and to investigate the causes of faulty packs. The other section consists of the demonstration

factory in which an up-to-date full sized line of canning machines is installed, also some modern machines for can-making. The objects of the demonstration canning plant were twofold; firstly to ensure that the machinery, which the canners are recommended to install, could be worked satisfactorily under the conditions prevailing in this country, and secondly to demonstrate practically the benefits to be gained by the use of modern machinery. Both these objects have already been achieved successfully, the machinery has proved itself very suitable for use in this country, and many, if not all, of the canners are favourably impressed with the advantages of installing similar machines in their factories. One exhauster similar to the one installed at the station has been ordered, and had it not been for the uncertainty caused by the international situation more orders would probably have materialized.

This excellently equipped research station supplies technical information and advice to canners free of charge, not only on matters connected with the canning of pineapples and pineapple products but with the canning of any local foodstuffs, and judging by the numerous enquiries and requests for information which have been answered, the establishment of the station has already been largely justified.

Research work

In addition to the examination of raw materials, finished products and waste products, and the laboratory study of problems submitted by correspondents, some 75 canning trials have been carried out at the research station with the object of collecting as much information as possible concerning the canning of pineapples and to help to improve the present method of processing.

Canning Sarawak pines

The variety of pineapple known locally as the Sarawak pine is very similar to the Smooth Cayenne variety which is canned in huge quantities in Hawaii and produces what is usually regarded as the best canned pineapple obtainable. In spite of the general belief of the local canners that the Sarawak pine could not be canned successfully it was felt that exhaustive canning trials should be carried out, and arrangements were made with the State Agricultural Officer, Johore, to plant some four acres of these pines at the Kota Tinggi Pineapple Experiment Station in Johore. These plants started to come into bearing towards the end of 1939. Preliminary trials soon indicated that Sarawak pines could be canned satisfactorily, using much the same processes as used for Singapore pines, but unlike the Singapore pineapple, which is unaffected by overcooking up to twice the normal cooking time, the Sarawak pine tends to disintegrate if seriously overcooked; possibly for this reason the local canners had condemned this variety as unsuitable for canning.

The average weight of all the fruits used in the canning trials was 4 lb. 3 oz. which is some $1\frac{1}{4}$ lb. more than average Singapore pines. The fruit appeared to be in prime condition for canning when the two or three lowest whorls of fruitlets showed yellow colouration, it was more uniform in size and shape than the Singapore pine, and was comparatively free from disease.

The colour of ripe Sarawak pines when canned is an attractive straw yellow colour, which, although it cannot be compared with the golden yellow colour of ripe Singapore pines, closely resembles the colour of Hawaiian canned pineapple. Unripe Sarawak fruit when canned is white, and over-ripe fruit tends to produce spots of brown discolouration and therefore cannot be used; it will be realized, therefore that there is no degree of ripeness in Sarawak pines which corresponds to the standard grade for Singapore pines.

The flavour of Sarawak pines when canned is more pronounced than that of the Singapore variety, resembling more nearly the flavour of Hawaiian canned pineapple; it is sweeter but has not such an attractive acid tang as the Hawaiian fruit. The preference for Singapore or Sarawak canned pineapple is of course a matter of personal taste, but it is probable that the majority of people would prefer the Sarawak flavour. During a visit to the canning research station by many of the canners and representatives of exporting firms a number of dishes of Singapore canned pineapple

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This partial standardization has proved a success, it has greatly simplified the packing and has helped to stabilize the market and standardize the pack. It is now generally approved by the industry and several of the large canners have expressed the opinion that they would now welcome a change over to full standardization, limiting the number of sizes to about five and all corresponding exactly to United Kingdom and American sizes, with the exception of the 1½ lb. Squat size, which is a can peculiar to this industry and for which there is no United Kingdom or American equivalent.

Malayan mark grading scheme

The regulations for the Malayan Mark Grading and Marking Scheme came into force about the middle of 1938; they were introduced as a voluntary scheme and up to date none of the canners have started to pack under the scheme.

Considerable work has been carried out at the Canning Research Station to draw up exact working definitions of the various factors of quality for marking and grading in order to standardize the examination of Malayan Mark samples, and to eliminate the human element as much as possible. Numerous samples were examined on Malayan Mark lines in order to perfect the technique of examination. Samples are now being taken every month from all operating factories for examination on Malayan Mark lines and reports on the samples are submitted to the canners with a view to making them familiar with the working of the scheme.

New canning research station

During the latter half of 1937 the Canning Officer transferred his office and laboratory equipment from Kuala Lumpur to a temporary building in Johore Bahru, in order that he might be near at hand during the erection of the buildings for the new canning research station at the 5th Mile, Scudai Road, Johore Bahru. The buildings for the station were completed before the end of 1937 and the office and laboratory were equipped and research work resumed, but owing to the international situation there was some delay in the delivery of the machinery for the demonstration factory, and it was not until early in 1939 that all the machinery was finally installed and the plant working.

The station consists of two sections, one containing a laboratory and small-scale canning plant, where canned foods can be examined and tests made on the raw products of canning such as tinplate and sugar, also where research work can be carried out to improve processes and to investigate the causes of faulty packs. The other section consists of the demonstration

factory in which an up-to-date full sized line of canning machines is installed, also some modern machines for can-making. The objects of the demonstration canning plant were twofold; firstly to ensure that the machinery, which the canners are recommended to install, could be worked satisfactorily under the conditions prevailing in this country, and secondly to demonstrate practically the benefits to be gained by the use of modern machinery. Both these objects have already been achieved successfully, the machinery has proved itself very suitable for use in this country, and many, if not all, of the canners are favourably impressed with the advantages of installing similar machines in their factories. One exhauster similar to the one installed at the station has been ordered, and had it not been for the uncertainty caused by the international situation more orders would probably have materialized.

This excellently equipped research station supplies technical information and advice to canners free of charge, not only on matters connected with the canning of pineapples and pineapple products but with the canning of any local foodstuffs, and judging by the numerous enquiries and requests for information which have been answered, the establishment of the station has already been largely justified.

Research work

In addition to the examination of raw materials, finished products and waste products, and the laboratory study of problems submitted by correspondents, some 75 canning trials have been carried out at the research station with the object of collecting as much information as possible concerning the canning of pineapples and to help to improve the present method of processing.

Canning Sarawak pines

The variety of pineapple known locally as the Sarawak pine is very similar to the Smooth Cayenne variety which is canned in huge quantities in Hawaii and produces what is usually regarded as the best canned pineapple obtainable. In spite of the general belief of the local canners that the Sarawak pine could not be canned successfully it was felt that exhaustive canning trials should be carried out, and arrangements were made with the State Agricultural Officer, Johore, to plant some four acres of these pines at the Kota Tinggi Pineapple Experiment Station in Johore. These plants started to come into bearing towards the end of 1939. Preliminary trials soon indicated that Sarawak pines could be canned satisfactorily, using much the same processes as used for Singapore pines, but unlike the Singapore pineapple, which is unaffected by overcooking up to twice the normal cooking time, the Sarawak pine tends to disintegrate if seriously overcooked; possibly for this reason the local canners had condemned this variety as unsuitable for canning.

The average weight of all the fruits used in the canning trials was 4 lb. 3 oz. which is some $1\frac{1}{4}$ lb. more than average Singapore pines. The fruit appeared to be in prime condition for canning when the two or three lowest whorls of fruitlets showed yellow colouration, it was more uniform in size and shape than the Singapore pine, and was comparatively free from disease.

The colour of ripe Sarawak pines when canned is an attractive straw yellow colour, which, although it cannot be compared with the golden yellow colour of ripe Singapore pines, closely resembles the colour of Hawaiian canned pineapple. Unripe Sarawak fruit when canned is white, and over-ripe fruit tends to produce spots of brown discolouration and therefore cannot be used; it will be realized, therefore that there is no degree of ripeness in Sarawak pines which corresponds to the standard grade for Singapore pines.

The flavour of Sarawak pines when canned is more pronounced than that of the Singapore variety, resembling more nearly the flavour of Hawaiian canned pineapple; it is sweeter but has not such an attractive acid tang as the Hawaiian fruit. The preference for Singapore or Sarawak canned pineapple is of course a matter of personal taste, but it is probable that the majority of people would prefer the Sarawak flavour. During a visit to the canning research station by many of the canners and representatives of exporting firms a number of dishes of Singapore canned pineapple

cubes were set out, among which one dish of Sarawak cubes was placed. No mention was made of what was in the dishes and those present were asked to taste and express their opinion as to the flavour. Almost without exception the visitors picked out the dish of Sarawak pines and commented on the excellence of the flavour.

Apart from the flavour there are two factors which favour the canning of Sarawak pines. Firstly, the percentage recovery by weight of cut fruit is greater than for Singapore pines, as shown in the table on page 275, and, secondly, Sarawak fruit does not absorb so much sugar during processing. In order to get the prescribed final density after canning of 17°Brix, a sugar syrup of lower density is required for Sarawak than for Singapore pines. It is calculated that a saving of about 1,200 lb. sugar would be effected in every 1,000 cases of 48 1½ lb. Squat cans.

These trials not only indicated that Sarawak pines could be canned successfully, but that this variety could be canned more cheaply than the Singapore canning pine, producing a pack superior in flavour, but lacking the bright golden colour of the Singapore fruit.

Canned pineapple juice

Considerable work has been carried out to investigate the process for canning juice of both Singapore and Sarawak pineapples. The majority of the experiments have been designed to produce a pineapple juice resembling as closely as possible the Hawaiian juice which is finding very large sales in the United States and elsewhere.

The colour and appearance of Singapore pine juice are excellent, but the flavour even of the fresh juice is inclined to be insipid, the colour of Sarawak pineapple juice is paler, but the flavour more pronounced. It has been found that the flavour of pineapple juice is very sensitive to heat treatment. Heating to temperatures above 175°F. or any heating at all in contact with the atmosphere causes deterioration of the flavour. Consequently the best results have so far been obtained by filling cans with cold fresh juice, closing at once, and pasteurizing the cans in tanks of hot water at 170°F. for half an hour. Many other and more complicated processes have been tried, but the simple method described above has so far proved the most successful. The flavour of canned Singapore pineapple juice when correctly processed is pleasant, although not very strong, whereas the local Sarawak pine juice has a more pronounced flavour. For this reason locally canned Sarawak juice should be more successful in finding a market than the juice from Singapore canning pines. The flavour of the juice from Singapore pines may be greatly improved by the careful blending of juices from ripe and unripe fruit, the proportions depending upon the degree of ripeness of the fruit. It has been noticed that small fruits from plants during their fourth or fifth year tend to give a juice of superior flavour. It is apparent that the blending of juice for commercial production would require very careful supervision.

Exhaust process

The exhaust process is employed in various forms in almost every type of canning process throughout the world, its main object being to produce a vacuum in the cans after closing, either by heat treatment before the cans are closed or by actually closing the cans in a vacuum. The advantages of the exhaust on canned pineapples are twofold: firstly, a marked improvement in the degree and uniformity of colour of the fruit is produced; and secondly, the vacuum prevents excessive distortion of the can during processing and greatly reduces the possibility of 'flippers' and 'blown' cans. All the known forms of exhausting have been tried out with variations, and the conclusion has been reached that the normal hot water exhaust of five minutes at 205°F. is the most practicable and satisfactory for use in Malaya. Canning trials have been carried out to find out the extent of the colour improvement due to this process as compared with the non-exhaust method. A marked improvement in colour was recorded in all grades of fruit from pure white unripe fruit to fully ripe golden fruit. The improvement in colour is most marked about the middle of the scale, with fruit which would normally be classed as standard quality. It is apparent that a large proportion of the fruit which is now packed as

standard grade would satisfy golden grade colour standards if packed using this exhaust process.

Closing machines

When the exhaust process is employed the open cans, containing fruit and syrup, emerge from the exhauster at 180 to 200°F. and are then immediately closed whilst hot. With the semi-automatic double seaming machines used at present in Malaya the cans are fed to and removed from the machine by hand and during the seaming process the cans revolve at high speed and a spray of syrup is thrown off. If these machines are used in conjunction with the exhaust process, the continuous handling of hot cans and the spray of hot syrup become extremely unpleasant for the operator, even if he is well protected with gloves and apron. The ideal way, and that usually employed elsewhere, is to close the cans on a fully automatic machine in which the cans pass to and from the machine without handling and the cans remain stationary during the seaming operations. Unfortunately it has been found, from experiments carried out at the canning research station, that the local hand-made cans cannot be closed satisfactorily on a fully automatic machine owing to the comparatively wide variations in their dimensions. Trials carried out closing hand-made cans on an automatic machine showed losses due to damaged or leaky cans of between 5 and 10 per cent, which, coupled with the stoppages in order to extricate the damaged cans, would represent considerable losses on a day's run. Similar trials using imported mahine-made cans were entirely satisfactory, losses of less than ½ per cent being recorded.

An alternative would be to use semi-automatic machines of a type where the can remains stationary during closing. A distinct disadvantage as compared with a fully automatic machine is that the maximum capacity for a semi-automatic is 35 cans a minute as compared with a capacity of from 60 to 120 cans a minute for a fully automatic machine. A semi-automatic machine is on order for the purpose of obtaining definite data as to its suitability or otherwise to local conditions of work.

On the other hand it may be possible to improve the locally-made can sufficiently to make its use with a fully automatic machine practicable, with or without some form of preliminary automatic gauging and discarding of such cans as are outside the limits of tolerance of the fully automatic machine. Preliminary investigations have shown that, considering the conditions of manufacture, local cans are extremely well made, denoting very great skill on the part of the can makers. One marked fault noted is that nearly all the mandrels, around which the can bodies are bent to facilitate soldering the side seam, are so worn and out of shape that it is surprising that the variation in size is not very much greater than investigations have shown. Body soldering mandrels have been ordered from England and further investigations into the possibilities for improvements of locally hand-made cans must await their arrival. The obvious alternative would be to change over to machine-made cans and this may have to be the ultimate solution. The possibility has received consideration, but in view of the skill shown to be possessed by the Chinese can makers it is felt that the capabilities of the locally hand-made can must be fully explored before it can be advocated that a change over to machine-made cans should be made, entailing, as it necessarily would, a considerable capital outlay. In any case, existing circumstances make the establishment of a central can-making plant in Malaya unlikely for the present.

Rubber solutions for closing

The present use of rubber rings applied by hand is unsatisfactory for several reasons, one of which is that the variation in thickness of the rings often causes particles of rubber to be squeezed inside the cans during the seaming process. Complaints regarding this have been received from time to time.

Machines for applying rubber solution to can ends are installed at the canning research station and the results, using an imported rubber compound, have been entirely satisfactory. Demonstrations of the machines in operation have been held and several of the canners expressed themselves in favour of

installing similar equipment. At present the high cost of the imported rubber solution is a deterrent; consequently experimental work is being carried out at the station, using concentrated latex and other rubber compounds which could be manufactured locally comparatively cheaply, and the results so far obtained have been very promising.

Pineapples of average weight

For the purpose of calculations the canners state that 70 fruits of an average size are required to fill one case of 48 1½ lb. Squat cans with cubes. Canning trials were carried out to find out the actual weight of pines of average size. Pines from various districts were taken and divided into batches containing pines of similar weight, each batch was then cut separately into cubes and the cubes filled into 1½ lb. Squat cans and the number of cans filled noted. From these figures the number of pines required to fill 48 1½ lb. Squat cans was calculated. It is interesting to note also that Sarawak pines give a better yield of fruit than Singapore pines. This is due to their having shallower eyes than the Singapore canning pineapple, only 55 Sarawak pines of 3 lb. weight being required to fill one case.

During these trials, records were kept of the weights of fruit before and after cutting, and from these the percentage recovery of cubes and slices was calculated.

Variety of pineapple	Average percentage recovery by weight				
	Fruits under 2 lb.	Fruits 2 to 3 lb.	Fruits 3 to 4 lb.	Fruits 4 to 5 lb.	Fruits over 5 lb.
Singapore canning cubes	20·2	19·4	20·7	20·3	..
Sarawak pines cubes	..	21·8	24·8	23·6	27·2
Singapore canning R. C. slices 1½ lb. tall cans	..	22·2	27·2	..	..
Sarawak pines R. C. slices 2½ lbs. tall cans	..	..	30·0	34·5	..

General research work

Other research work, covering such subjects as pineapple waste utilization, can-lacquering trials, composting pineapple waste, the manufacture of pineapple jam, etc., has been carried out.

Following the formation of the Central Board in October, 1938, up to the outbreak of the war, conditions in the industry improved steadily, prices had risen and were maintained at profitable levels, the growers were receiving fair prices for their fruit, and the market for canned pineapple was on the up-grade. A general improvement in the quality of the pack could be noticed during the two years, but little progress had been made with the re-equipment of the factories with up-to-date machinery.

Since the outbreak of war the position of the industry has become somewhat precarious. Very large increases in the cost of tinplate and other materials required for canning have made it necessary for the Central Board to increase their selling price considerably. All existing contracts and exports of canned pines to Great Britain were taken over by the Ministry of Food in May, and over 80 per cent of the normal exports to Canada have been lost due to an import ban on all but golden grade fruit going into Canada.

New Books and Reviews

The Cooperative Movement in Bengal
By J. P. Niyogi (Macmillan & Co., Ltd., 1940: pp. 268, 10*s.* 6*d.*).

THE cooperative movement in India, particularly its most important section, viz. that dealing with agricultural credit, has been in a bad way for some years past. Its position was worsened by the economic depression, and the prevailing war conditions have not helped in its improvement. Efforts are being made in the various Indian provinces and states to rectify and revive the movement. It has, therefore, become necessary to investigate thoroughly the organization and working of cooperative credit societies in order to be able to suggest correct remedies for the rehabilitation of the movement. Dr J. P. Niyogi, Minto Professor of Economics in the University of Calcutta, has done this work for the province of Bengal. The book before us embodies the results of his enquiry and it is intended to 'throw light on the working of cooperative credit and marketing societies in Bengal, so as to prepare the way for more enlightened plans for improving agricultural credit societies'. After reviewing the development of primary credit societies the author has subjected the constitution and working of these bodies to a critical examination and has placed his finger on some of their weakest features. He draws attention to the fact that though the heavy overdues in primary societies can, to a large extent, be attributed to the slump in agricultural prices which set in 1929, recoveries were very unsatisfactory even before that date. He remarks: 'It is no doubt true that the deterioration in the position of credit societies has been the outcome largely of the slump of 1929. But it is difficult to overlook the fact that, long before the first symptoms of depression manifested themselves, the proportion of overdues was fairly high...' It is not therefore possible to maintain that the only factor responsible for the arrears in collection has been the absence of repaying capacity on the part of the ryot due to the fall of prices.'

Dr Niyogi's diagnosis of the trouble is clear, and it ought to make every one associated with the working of the cooperative movement pause and think. He attributes the deterioration of societies to the violation of those essential principles on which rural credit depends. 'The manner in which loans have been granted, the uses to which such loans have been put and the lack of any effective supervision that has characterized the relations between primary societies and the financing banks are some of the contributory causes that have brought the credit societies to their present decadent state.' The working of central banks and of the provincial and land mortgage banks has been subjected to a similar searching analysis and the criticisms offered are highly suggestive. The author's observations regarding the difficulties that are bound to beset the path of the expansion of primary societies into multi-purpose societies are worthy of serious consideration. The chapters on cooperative marketing are informative and stimulating. The importance of linking up marketing of produce with credit has been properly stressed and the lines on which this business should be organized have been clearly indicated.

Every one interested in the reorganization and healthy progress of the cooperative movement in India will welcome Dr Niyogi's book. He has brought freshness of view and independence of judgement to bear on the discussion of the problems of cooperation and provincial Governments as well as workers in the movement should profit by his investigations and conclusions. His shrewd comment on measures adopted for the 'conciliation' of agricultural debts will bear quotation: 'But all such remedies for alleviating the burden of indebtedness, whether along individualistic or cooperative lines, should form only a part of a larger plan of rehabilitation of agriculture and cottage

industries. Indebtedness, it is often forgotten, is both a cause as well as a consequence of poverty. Measures for the relief of indebtedness, however well-intentioned, can only be in the nature of a palliative if they are not accompanied by a comprehensive programme having for its object the improvement in the economic position of the cultivators.'

[V. G. K.]

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The Indian Cotton Textile Industry (1940 Annual)

By M. P. Gandhi, M.A. (Gandhi & Co., 14/2, Old China Bazar Street, Calcutta: pp. 150, Rs. 3.)

THIS book gives a brief account of the important developments connected with the Indian cotton textile industry during 1939-40. The main review is preceded by 15 tables containing information on the progress of the Indian cotton mill industry, production, imports, exports and consumption of cotton and cotton piecegoods, imports and exports of cotton twist and yarn and changes in customs tariff on cotton yarn and piecegoods. In table 15, the author estimates the total consumption of cotton piecegoods in India during the year ending March 1940 at 5,960 million yards, out of which about 65 per cent was accounted for by Indian mill production, 26 per cent by handloom production and the balance of 9 per cent by imports. On this basis the *per capita* consumption of cotton piecegoods in 1939-40 is estimated at 16·5 yards against 17·0 yards in 1938-39.

In the main review which also contains a brief historical survey of the industry, the author in referring to the effects of the present war on the Indian cotton textile industry, as compared with the Great War, expresses the opinion that the industry will not get as much scope for expansion as in the last war.

The appendices, besides dealing with the progress made in the improvement of the Indian cotton crop and the development of the handloom industry, contain a list of cotton mills in India and a statement showing capital and dividend pertaining to cotton mills. The *Annual* should prove informative and useful to those interested in the Indian cotton textile industry.

[D. N. M.]

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Insect Pests of Burma

By C. C. Ghosh, B.A., F.R.E.S. (Superintendent, Government Printing and Stationery, Burma, 1940: pp. 216, Rs. 7-8.)

MR Ghosh deserves congratulations on his book, *Insect pests of Burma*, which is a very timely publication, considering that there is at present little available information on the Burman insect pests. In this publication an attempt has been made to acquaint general readers with the elementary facts about insect life and with the common insect pests which have been observed to occur in Burma. Simple methods, wherever possible, have been suggested for action against the pests. Technical descriptions have been reduced to the minimum and the publication appears to be meant primarily for general readers. The book is divided into two parts. Part I deals with general facts about insect life, classification, and the prevention and control of damage by insects, both chemical and biological. Part II deals with the general pests and the pests of the different agricultural crops. In addition, Part II gives useful information on the pests of garden plants, plantation crops, fruit trees and the pests in houses and stores. The get-up of the book is excellent and the illustrations are profuse and very well produced. The book is a valuable addition to the literature on tropical insect pests.

[S. C. R.]

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Books Received

Messrs Longmans Green and Co. have produced on behalf of the British Council, London, a series of illustrated pamphlets on British Life and Thought. The pamphlets, priced at 1*s*. each, deal with present-day topics of general interest and are written by expert economists, lawyers and scientists.

The British System of Government by W. A. Robson, Ph.D., LL.M., B.Sc. (Econ.).

British Justice by Sir Maurice Amos, K.B.E., K.C.

British Education by J. E. Hales.

The Face of Britain by L. Dudley Stamp, B.A., D.Sc., A.K.C., F. Inst. Pet., F.R.G.S.

British Sport and Games by Bernard Darwin.

The Englishman by the Rt. Hon. The Earl Baldwin of Bewdley, K.G., F.R.S.

The British Social Services by A. D. K. Owen.

Liberty : Principles and Practice by Rt. Hon. Viscount Samuel, G.C.B., G.B.E., Hon. D.C.L. (Oxford), M.A.

From all Quarters

OPIUM IN CAMELS' STOMACHS

An interesting case of the use of science in the perpetration of crime as well as in its detection is published in the Annual Report for 1939 of the Central Narcotics Intelligence Bureau, Cairo, Egypt. Though definite information was available that narcotics were smuggled through the stomachs of the camels intended for the meat market, yet difficulty was experienced in determining the camels carrying the narcotics owing to the large number of camels entering Egypt annually from the East. The main ground for suspicion was that the owners refused to sell camels which were not worth £ E. 3 even for such a high price as £ E. 10. Hence some camels were detained at El Arish and the Mamour of Kantara for examination and when they were slaughtered, containers carrying narcotics were found in the first stomach. An interesting feature of this case was the strange ability of the camels to carry containers weighing 250 gm. in their stomachs and to travel and work with little or no inconvenience to themselves. Since the number of animals passing through the quarantine stations is large and since much reliance cannot be placed on information, it has been decided by the Egyptian authorities to apply scientific methods for the detection of the containers. For this purpose each station will be equipped with an X-Ray or other similar device and a certain proportion of the camels that pass through these stations will be submitted to its 'searching beam'.

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PROF. KOCH'S VISIT TO MUKTESWAR

In the supplement issued with INDIAN FARMING, Vol. I, No. 11, last November, to commemorate the Golden Jubilee of the Imperial Veterinary Research Institute, Mukteswar, a group photograph (Plate III) taken at Mukteswar on the occasion of the visit of Professor Koch in 1897 was reproduced The identity of some of those in the group was not known, and in three cases, it now appears, was incorrectly given.

We are obliged to Colonel H. T. Pease, one of the group in the photograph, now retired in England, for naming the group. The photograph is again reproduced in this issue (plate 81), with the names correctly given in the caption.

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BOMBAY VETERINARY COLLEGE

With effect from 15 June 1940, a revised curriculum has been introduced at the Bombay Veterinary College and additional staff has been engaged so that the subjects can be efficiently taught. The new curriculum is that recommended by the Imperial Council of Agricultural Research and its introduction involved the raising of the standard of admission from Matriculation to Inter-Science (B. group).

The College is run in conjunction with the Bai Sakarbai Dinshaw Petit Hospital for Animals where clinical instruction is given. During the quarter ending 30 September 1940, 680 in-patients and 1,134 out-patients were treated by the College staff in the hospital.

At the College laboratory material received from the field staff is subjected to examination and reports issued, in addition to giving practical instruction in bacteriology, pathology and parasitology to students under training. The officer in charge of the laboratory is also responsible for the production of goat adapted rinderpest virus for use in the field in the control of rinderpest.

The College is the oldest Veterinary College in India and was opened in 1886. The first Principal was Mr John Henry Steel, while Rao Bahadur V. R. Phadke, who was Principal from 1932 to 1937, was the first graduate of the College to attain that position.

MGIPC—M—III-1-1—2-5-41—1,800.

INDIAN FARMING

ISSUED BY
THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

Vol. II : No. 6
JUNE 1941

Subscription ; Rs. 6 per annum : 8 as. per copy

PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
PRINTED BY THE MANAGER, GOVERNMENT OF INDIA PRESS, CALCUTTA

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1800

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Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Imperial Council of Agricultural Research, Imperial Secretariat, New Delhi.

The subscription is Rs. 6 per annum, 8 as. per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertisements should be made to the Manager of Publications, Civil Lines, Delhi.

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LOOK TO THE LAND

SINCE the war began, Great Britain has had perforce to become agriculturally minded. About four million additional acres have been brought under cultivation and the present emphasis is on maximum production of foodstuffs. Those who insist on maximum production are sometimes inclined to forget the need for keeping up soil fertility. A book* recently published, whose title is also the title of this editorial, is a plea for soil salvation. It is not, strictly speaking, a war book, as it appears to have been written in the summer of 1939 although not published till 1940. The general spirit of the book is one of which there have been many manifestations recently, i.e. an insistence on the use of organic manures and a deprecation of the use of artificials. The author does not quite go the length that some devotees of this cult go, who speak of dung as if it were a holy thing and artificials as something satanic. But there is more than a suspicion of this along with a mystical attitude towards soil nutrition, animal nutrition and plant nutrition. The author is inclined to be impatient with the slowness of science and its insistence on verification and is prepared to act on impressions or intuitions. Otherwise he thinks action might be too late. He is also inclined to believe the statement that has been made by certain writers, viz. that there is a growing susceptibility to disease in plants and animals, which he puts down to wrong feeding and, in the case of plants, mainly to the lack of organic manure. It is of course an open question whether one can compare nutritional diseases in plants with nutritional diseases in animals, or susceptibility to fungus and insect pests in plants with susceptibility to bacterial and other diseases which attack animals. It is highly questionable whether previous generations were more resistant to dirt and disease than we are. Even the skeletons of prehistoric men show the presence of rickets, and a contemplation of graveyards in this country reveals a very high mortality of very young people. Similarly as regards plant diseases, Lord Northbourne argues that these have increased because spraying has increased. There are few facts, if any, to substantiate either this view or its opposite. It is much more likely that spraying has increased because farmers are much more conscious of the damage done and profits reduced by diseases. This certainly was the case in the vineyards of Nasik, in the Bombay Province.

Having said all this and allowing for the fact that in a popular book a certain lack of detailed argument may be permissible, the fact remains, that the author has produced a thought-provoking work worth consideration by all classes in India, not only farmers but also industrialists and administrators. The soil is the source of wealth. The physical retention of it in its place and the maintenance and increase of its fertility are matters of fundamental importance in a nation's life. Not less important is the spiritual and bodily welfare of those who make their living from the land and who, in India, form the bulk of the population but are unorganized and inarticulate.

To maintain soil fertility the Agricultural

* *Look to the Land* by Lord Northbourne (J. M. Dent & Sons, Ltd., London, 1940, pp. 206. 7*s*. 6*d*.)

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To maintain soil fertility the Agricultural

* *Look to the Land* by Lord Northbourne (J. M. Dent & Sons, Ltd., London, 1940, pp. 206. 7*s*. 6*d*.)

Departments in India have for long been insisting on the need for the conservation and use of every scrap of organic manure available and for this purpose have been pushing with all their ability the manufacture and use of compost. There are many methods of making compost and half the art of compost-making lies in knowing what modification of the main principles to apply to particular material and particular circumstances. This information the Agricultural Departments of provinces and states are in a position to supply. The much greater use of town refuse, which is advocated in this book and which is also the subject of an article by Dr G. T. Wrench elsewhere in this issue as a war measure is another way of bringing back to the land organic material which was originally taken from it. At present, it is necessary to do everything possible to increase the yield of rice. The present comparative cheapness of groundnut-cake should also be a considerable stimulant to the use of that excellent nitrogenous fertilizer, particularly in view of the present scarcity and dearness of nitrogenous artificial manures. Green manuring, which is in many cases financially the cheapest of all nitrogenous manures, although it means a certain consumption of agricultural time, is also one of the practices strongly recommended by the Agricultural Departments of India for a variety of crops and has been successful in many cases, particularly in connection with sugarcane and rice.

Lord Northbourne expresses a rooted dislike of large-scale farming and desires a continuous intensification of small-scale farming, so that the farmer may be a craftsman proud of his craft with a farm as self-contained as possible and that he and his family should be the basic social unit of Lord Northbourne's new order. If large-scale farming necessarily meant soulless landlordism by distant corporations then it would be wholly bad. But it is surely possible for farmers to live and develop on the lines suggested by Lord Northbourne within a framework which would give them many of the advantages of modern science and organization and at the same time not interfere unduly with their individual abilities and desires. This type of problem is just the sort of thing which democracy is out to solve and, if human values are kept in their right place, such problems will be solved. Incidentally, it is easier in large-scale farming to get rid of the inefficient farmer whom Lord Northbourne also desires to see eliminated than in purely individualistic small-scale farming.

Lord Northbourne is an advocate of mixed farming. This is particularly of interest to India in view of the chain of mixed farming experiments which are just being started by the Imperial Council of Agricultural Research in a number of provinces. 'Mixed farming', however, is not a panacea, and fertility can be built up under specialized farming if done intelligently and can be lost under 'mixed farming' if the 'mixed farming' is done unintelligently. The evils of monoculture or one-crop farming no one will deny, particularly in producing conditions where disease cannot be kept at bay. The so-called 'weakening' of plants due to bad soil conditions on which Lord Northbourne insists may well be due to nothing mystical but to the weakening of the biological activity of the soil and particularly of those beneficent micro-organisms that keep plant-disease organisms in check.

Lord Northbourne has various remarks of a more or less general nature on economics, finance and land nationalization, all of which are stimulating reading whether one agrees with them or not. Many will disagree with his condemnation of organization of farming and of money. With Lord Northbourne's estimate and classification of human and agricultural values, few thinking people will quarrel.

S. D. JOSHI, B.Sc. (Lond.)

An Appreciation

A FEW days ago I met some well known sugar factory owners of this province, and we got on to the subject of milling tests for new varieties of sugarcane. Various difficulties were discussed and it was suggested that a committee of technologists might meet

S. D. Joshi, B. Sc. (Agri.) (Lond.)
Late Deputy Director of Agriculture, United Provinces, Lucknow

[PLATE 82

SUB-SOIL IRRIGATION

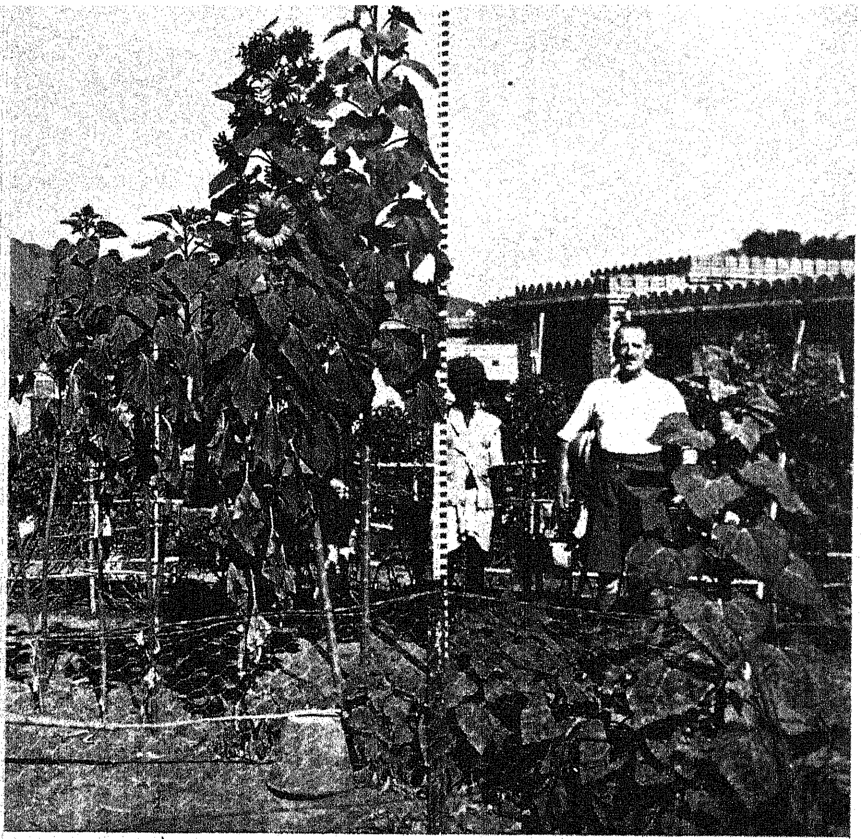
In spite of the drought in Ajme Lt.-Col. G. Howson was able las year to maintain a garden wit the help of sub-soil irrigation

Lines of hand-made earthen ware pipes were laid 12 to 1 inches below the surface, seve feet apart. The water seepin out through the open joints an through the porous pipes su plied moisture to the roots o the plants growing above them.

The soil is a light sandy soi and capillary action brought th moisture almost to the surface.

Excellent results wer obtained with *dhub* grass cauliflowers, celery, lucerne an berseem.

The photographs were take at the end of March.



PLATE

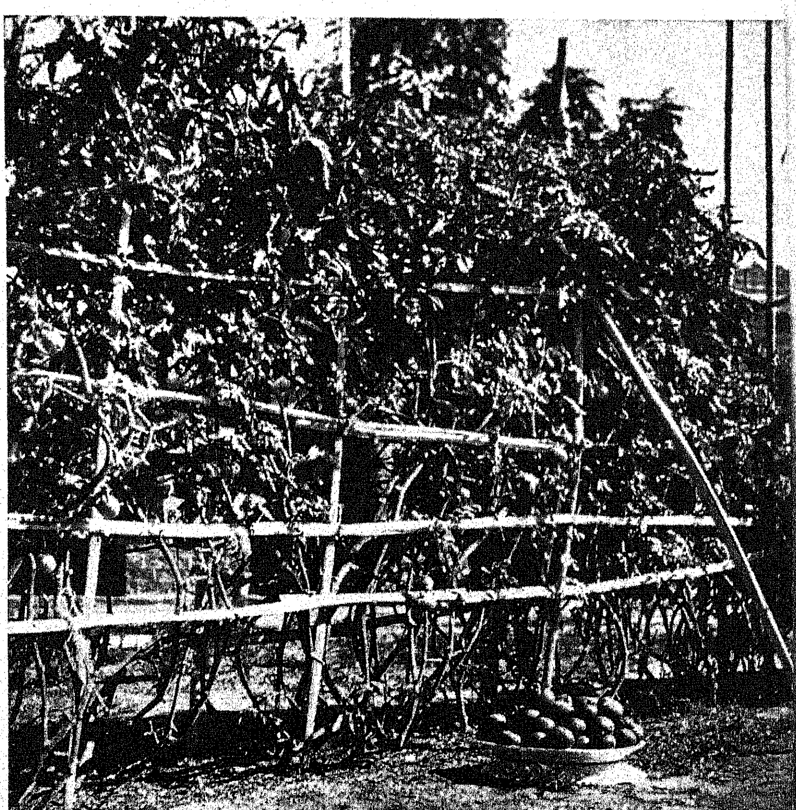
Above: A luxuriant growth of sunflower planted for a fodder experiment.

The rod measures 11 feet. The seed was sown in early January.

The sunflower in the foreground was a later sowing.

Right: Tomatoes at the end of a hot, dry and dusty March, showing rich foliage and no sign of curly leaf.

The fruit, when picked in the early morning, were, literally, icy cold and full of juice. The foliage was a much deeper green than the foliage of any surface-watered plants.



to evolve a workable plan. When names were being discussed one of them suggested that Mr S. D. Joshi must be asked to attend. I said that poor Mr Joshi died two months ago. There was silence in the room for several minutes. The remarks that came spontaneously were: 'He was a good man. We saw him last year when he was not quite well and yet in the middle of the day in July he spent hours going himself into the fields and collecting red rot samples.' Another man remarked that there were few men in this province who knew more about sugarcane.

These remarks illustrate the respect in which Mr Joshi was held in this province. He joined the Department in 1921 as a research assistant in the Plant Pathology section. Soon after he took study leave and obtained the B.Sc. degree in Agriculture from the University of London. In 1927 he became a Deputy Director and last year he officiated for a short period as Cane Commissioner to the U. P. Government. He was only 46 years of age at the time of his death. His was a career full of promise and we had great hopes of him. A most conscientious and devoted officer of this Department is gone.—VISHNU SAHAY, I.C.S., Director of Agriculture, U. P.

Original Articles

THE USE OF TOWN WASTES AS A WAR MEASURE

By G. T. Wrench, M.D. (Lond.)

It is now generally admitted that the growth of the large towns of the industrial era has deprived the soil of a great mass of organic waste that should go back to it.

It is also generally admitted that in modern war a well-fed and fertile soil is a great asset.

It is the object of this article to bring these two truisms together and see what case they make for the agricultural use of town wastes as a war measure.

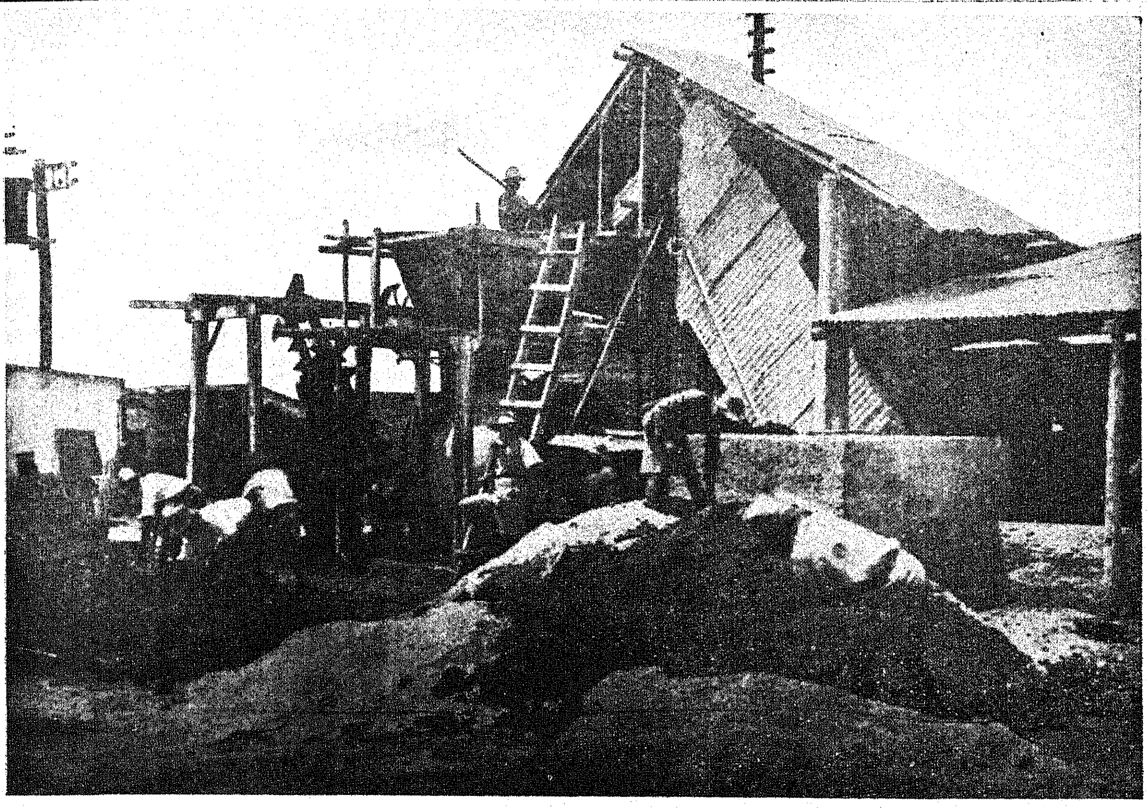
Up to a century ago, it was customary for the nightsoil and refuse of the poorer parts of English towns to be piled in the streets and upon waste ground until carried off by farmers. There was no public sanitary system, and the historian, J. R. Green, states that as late as 1844 only two towns were known which had a public service for the poor. This service eventually developed into the hydraulic sewage system and the collection of other waste for burning or dumping.

Waste: achievement of civilization

No one has described what this change has meant to the soil more convincingly than the late F. H. King, Chief of Division of Soil Management, United States Department of Agriculture, in his famous book, *Farmers of Forty Centuries*, written before the war of 1914-18, but first published in England in 1926. Here only the estimated figures of the soil's loss can be given: 'On the basis of the data of Wolff, Kellner and Carpenter, the people of the United States and of Europe are pouring into the sea, lakes and rivers, and into underground waters, from 5,794,300 to 12,000,000 lb. of nitrogen, 1,881,900 to 4,151,000 lb. of potassium, and 777,200 to 3,057,600 lb. of phosphorus per million of adult population annually, and this waste we esteem one of the great achievements of our civilization. In the Far East, for more than thirty centuries, these enormous wastes have been religiously saved, and today the 400 millions of adult population send back to their fields annually 150,000 tons of phosphorus, 376,000 tons of potassium, and 1,158,000 tons of nitrogen comprised in a gross weight exceeding 182,000,000 tons. They are gathered in every home, alike in country villages and great cities.' King, after a fierce denunciation of 'man the most extravagant accelerator of waste the world has ever endured,' continued with the specific loss of phosphates due to hydraulic sewage, based upon a number of people like to that of the Far Eastern Mongolian people: 'Modern civilization is adding [to the loss of silt] that of hydraulic sewage disposal, through which the waste of 500 millions of people might be more than 194,300 tons of phosphorus annually, a waste which could not be replaced by 1,295,000 tons of rock phosphate, 75 per cent pure. The Mongolian races, with a population now approaching the figure named; occupying an area little more than one-half that of the United States; tilling less than 800,000 square miles of land, and much of this during twenty, thirty or perhaps forty centuries; unable to avail themselves of mineral fertilizers, could not tolerate such waste and survive.'

Dangerous deprivation in war-time

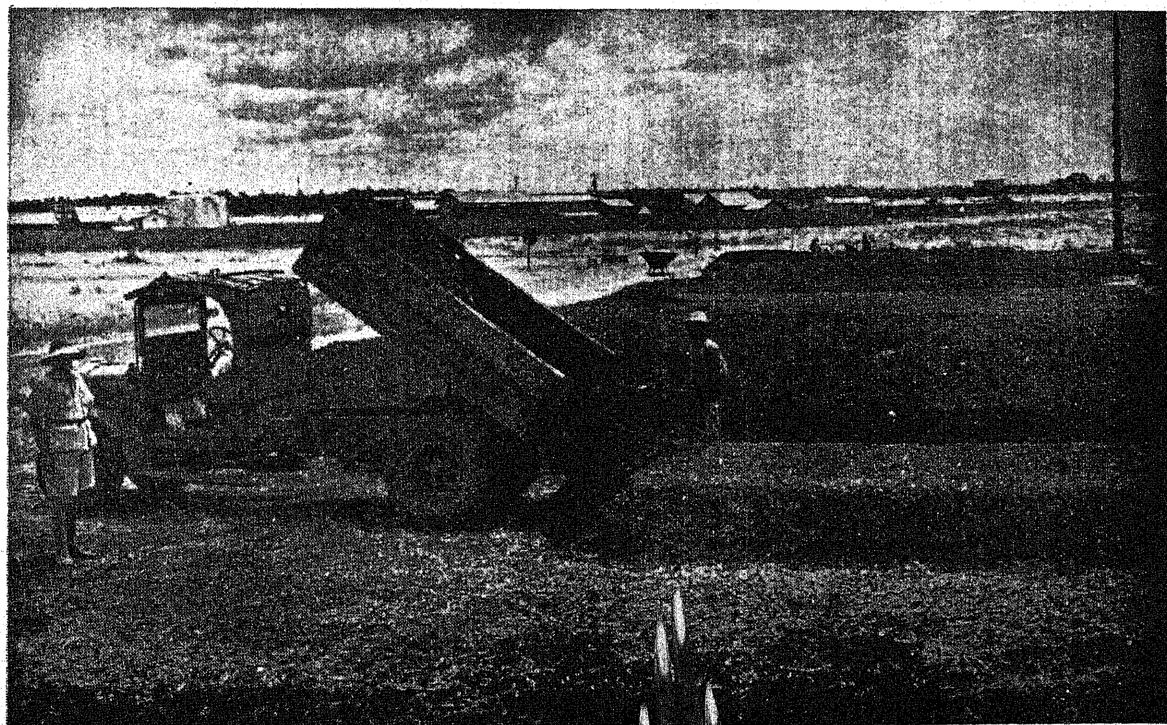
'Could not tolerate and survive': as far as language could convey a warning that all was not well with man in his brave, new, self-made, scientific and industrial world, these words conveyed it. Yet, though King by no means stood alone amongst soil specialists, the warning received little or no public attention. It was scarcely to be expected. The reading public were too urban-minded to be able to value it correctly, and the agriculturists themselves seemed to be too unaware of their own primal importance and too engrossed by the immediate problems of the land they were cultivating to realize its significance to them as a class and add their voices to the warning. They were, in any active sense, untouched by it. There, however, the words and the facts



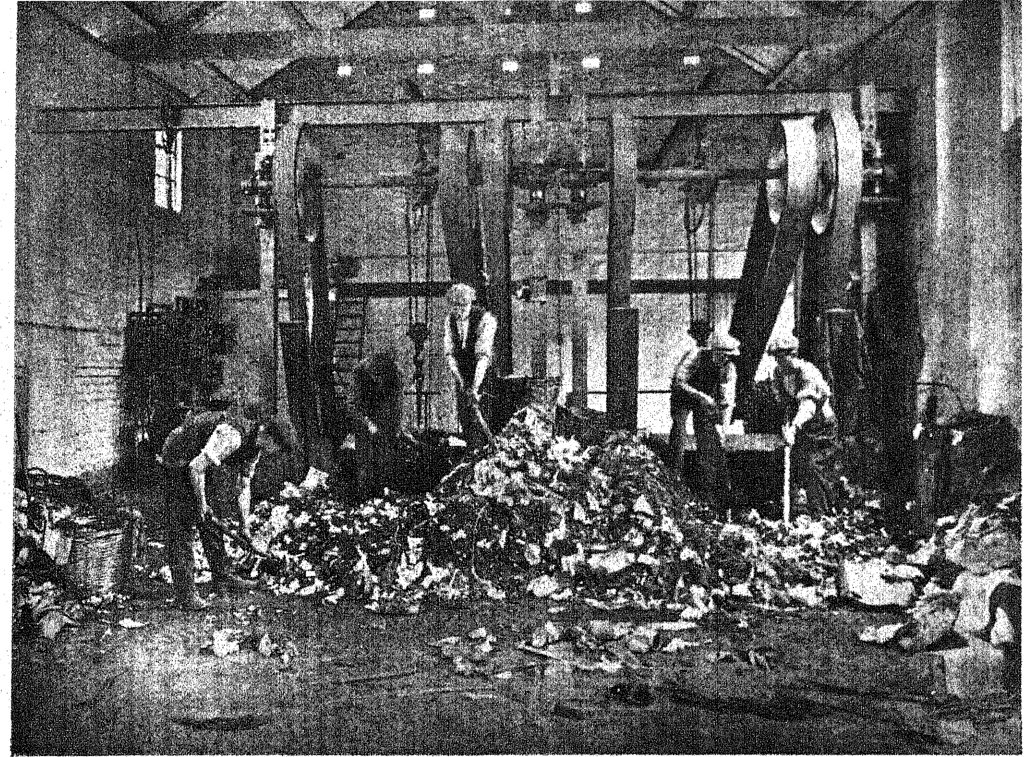
Preparing town wastes at Nairobi

Fermentation of town wastes at Nairobi

[PLATE 84

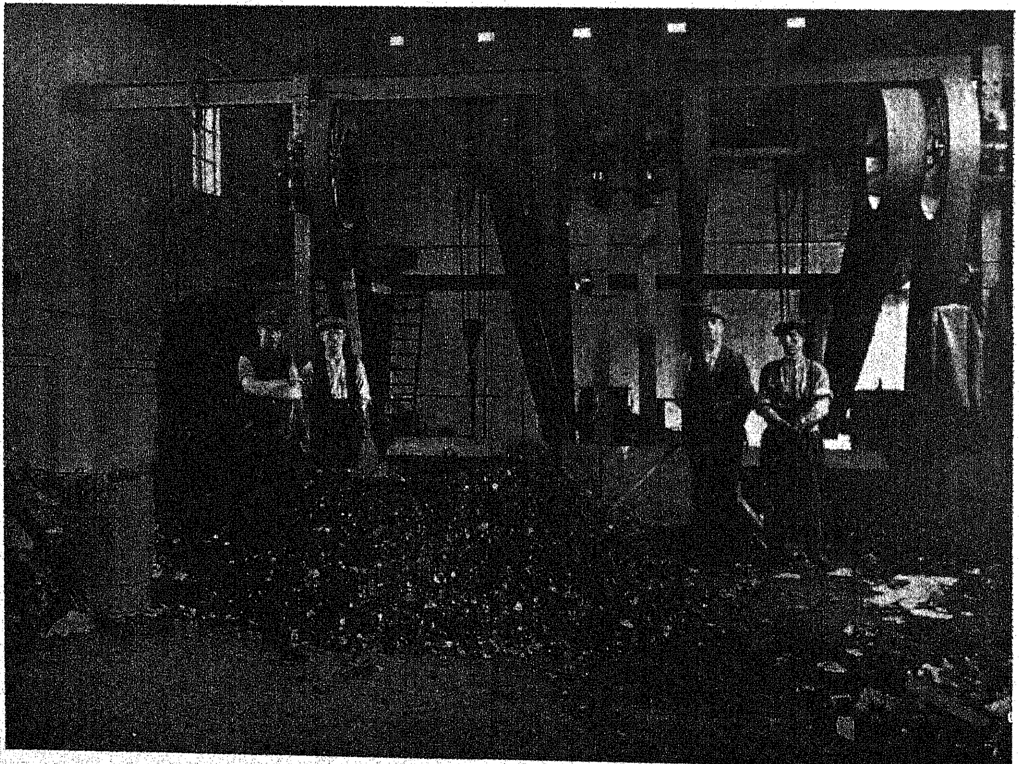


Photographs reproduced from 'The Manufacture of Humus from the Wastes of the Town and the Village', by Sir Albert Howard



Crude refuse being fed into a two unit plant erected in London

This photograph shows the same refuse after pulverization by the Lightning Masticator



Photographs reproduced from 'Treatment of City and Town Refuse'

stood, that under modern civilization the soil was robbed of its natural food and that the towns were particularly guilty in this unconscious crime. Civilized man, in his pride and progress, seemed to have forgotten that he remained terrene, the product of the soil.

It would, nevertheless, be clear that this deprivation would be more dangerous at a time of war. Great Britain had an experience of this, not known to her people at the time, but well understood by her Government, when, in the war of 1914-18, she stood within a few weeks of starvation. The Germans realized it when, though the war ended, the partial starvation, which it brought about, did not end. The supply of food and the home agriculture played a most significant part in the course of the war.

Lesson forgotten

Strangely enough, in Britain the warning of the war seemed to be quickly forgotten. In the following years of peace there was no great agricultural revival. On the contrary, Professor Stapledon stated in 1935 that 43 per cent of the land of England and Wales was 'in a more or less neglected condition—every single acre of this enormous area is capable of radical improvement.' In no country, indeed, did the significance of the war interpret itself in such words as those, which I have quoted from Mr King. As far as I have been able to find out, only one great town of Europe gave up its hydraulic system and reverted to turning its wastes into manure for the land. That town was Stockholm, the capital of Sweden with about half a million inhabitants.

It cannot, I think, be said that any nation after the war really faced the question of the use of town wastes. Artificial manures were regarded as a substitute, but they have not the physical effect of organic manures upon the soil. A number of tentative and successful experiments were tried with town wastes, but they were, and still are, the efforts of individual towns.

National support

Such towns, however, were given a national support in Britain in 1923. In that year, three years before the appearance of King's book in England, the British Ministry of Agriculture issued a leaflet (No. 398) on 'Town Refuse as Manure' for the limited reason that motor cars and lorries had driven horses from the roads with a consequent loss to the farmers of their stable manure. The leaflet recommended town waste as a substitute and named the following towns as selling wastes to farmers: London, Glasgow, Perth, Dundee, Aberdeen, Rochdale, Warrington, Bury, Sheffield, Hove and Gateshead. Of these Gateshead was the most thorough. Eighty per cent of the houses of Gateshead at that time had earth, not water, closets. Their contents, stable manure, slaughter-house refuse and other town waste, from which glass, metal and other hard substances had been removed, were together passed through a pulverizing machine and the crushed stuff sold at two shillings and six pence a ton. It was bought with eagerness. Two years ago I saw a number of mechanical plants for the use of town wastes in or near London. The Borough of Southwark has, since 1906, disposed of its household refuse by powdering it in a Lightning Crusher and selling it to farmers. The Borough of Kensington has an extensive plant for the manufacture of Hyganic. Outside London, Maidenhead and Leatherhead first crush refuse and then compost it with emulsions and sprays of sewage sludge. Other towns, which make use of town wastes, in the southern section of England are Harrow, St Albans, Birmingham and Colchester. Dr Garner estimated a few years ago that one-eighth of the sewage sludge, produced by treatment plants in England and Wales, was being used to increase soil fertility.

Sewage farms and the use of town wastes, therefore, show that there is a well-spread recognition that town wastes should *not* be wasted. They are too valuable. And when war comes, their value is yet greater. They can give additional soil fertility, which is an unquestionable addition of strength to countries at all times and especially at times of war. The German Government recognized this as regards the sewage factor of town wastes in its order to all municipalities to spend nothing on disposal works, until its use for increasing the food of the people had been met. The slogan had to be not 'sewage disposal' but 'sewage use.'

Progress in India

In India, now and in the past, the use of wastes has neither been so extensive nor so thorough as in the Far East. Messrs Jackson and Wad, in *The Indian Medical Gazette* of February 1934, wrote that though composting with nightsoil is in no way general in India, it is done in some areas. In the same issue of the *Gazette*, Mr J. J. Mieldazis, Sanitary Engineer, in an article entitled 'Organic Manure from Street Refuse and Nightsoil at Mysore City', wrote: 'The manurial value of a mixture of street rubbish and nightsoil is recognized to such an extent that agriculturists make periodic trips to the cities for the collection of these ingredients; the agriculturist loads his cart with alternate layers of this heterogeneous mass of refuse and nightsoil and carts the mixture to his fields, where it is formed into piles and allowed to decompose for four to six months. When it is sufficiently broken down to an odourless humus mass, it is used as a fertilizer on the fields.' He added a description of how the municipal officers aided the conservation of the wastes and placed them at the disposal of the farmers. Since that date the Municipal Council of Mysore has itself composted its waste and nightsoil. Bangalore does the same, as also a number of towns in the Madras Presidency and in Travancore. The Bombay Municipality tests the composting of its sludge and refuse; Nasik makes poudrette; Jamshedpur activated sludge; Ahmedabad is interested in refuse powdered by a crushing machine. Lastly, there are the towns that follow either the Indore or the Hot Fermentation methods. So one can marshall the following thirty towns as the vanguard of the use of town wastes for the soil: Mysore, Bangalore, Indore, Alwar, Rewa, Bharatpur, Datia, Neemuch Cantonment, Secunderabad Cantonment, Nanded, Tollygunge (Calcutta), Shahjahanpur, Sabour, Jaipur, Jodhpur, Madura, Cocanada, Conjeevaram, Tenali, Guntur, Tuticorin, Vizagapatam, Negapatam, Nellore, Alleppey, Jamshedpur, Nasik, Cawnpore, Ahmedabad and Bombay.

In increasing the use of wastes as a war measure, more rapid results can be procured from towns than from villages. But the use by villagers of their wastes, such as that brought about by propaganda in the Gurgaon district of the Punjab, is a measure of like kind. Artificial manures, which supply minerals that are deficient in the same way as some medical tonics supply deficiences in the case of invalids, have their share in promoting soil fertility as a war measure. However intricate their preparation may be, when they reach the cultivator, they are simple in application. Town wastes could reach the cultivators in an equally simple form. The methods in India of making them into manure, excluding the activated sludge process, are simple, and except where crushers are used, are non-mechanical and can be carried out by ordinary hand labour. Being simple, they do not take more than a few days to learn.

A war measure

The manure being made, the practical man sees many difficulties in getting it on to the land. But let us look at it at once as a war measure. As a war measure it would be given to local farmers as a war equipment in the same way as soldiers are equipped. Those of us, who have read such authoritative articles as that on banking and credit in the last, the fourteenth edition of the *Encyclopaedia Britannica*, believe that this can be done. Soldiers are creative in that they defend the people as a whole. They are indirectly creative as are hedges and fences, which, by keeping out marauding wild animals, make the cultivation of crops possible. Increased fertility is directly creative, being an increase of the source of life creation itself. In the soldier and the soil men must have faith in order to survive as a body politic. Credit is faith-money and all but a small percentage of money is now created as faith-money. Money, therefore, at a time of war has the function of equipping those measures of strength and safety, which are deemed necessary. If the increased fertility of the soil is recognized as one of these measures, a gift to the farmers of the equipment with which they can produce more and better products of the soil is practicable. It is probably also essential practically, for it is doubtful if the farmers would use the manure unless given as a war equipment.

THE LIVESTOCK INDUSTRY OF INDIA

By K. C. SEN, D.Sc., and T. S. KRISHNAN, M.Sc., A.I.C.
Imperial Veterinary Research Institute, Izatnagar

THE term 'industry' is apt to conjure up visions of huge factories in big cities where large numbers of people are engaged in producing a certain specialized type of article on a large scale. It also suggests the control of these institutions by a few wealthy capitalists. The raw material for the products concerned is brought to the factory, possibly from far away, converted into manufactured articles and sent out for distribution through specialized selling agencies. Such industries, for example those concerned with textiles, engineering, jute and sugar, are usually concentrated in one locality and are controlled by powerful vested interests who practically monopolize the production and sale of the respective articles.

In the above sense, it may not be very appropriate to speak of the livestock 'industry' of India, since in it there is neither organization, concentration, nor specialization. But from other and broader aspects, viz. the number of persons engaged in it, the capital value of the assets involved, the income derived therefrom, as well as the value and importance of its products for the health and prosperity of the nation, indeed for its very existence, the justification for calling it an 'industry' becomes apparent. Equal only to agriculture, with which it is indissolubly linked, and second to no other industry, its basic importance to the national welfare cannot be overemphasized.

While it is impossible entirely to separate agriculture from the livestock industry, that is animal husbandry, yet to a certain extent it is possible to gauge their independent contributions to the national economy. Dairying, cattle-breeding, sheep and goat rearing for wool and meat production, poultry husbandry, etc. are all sections of the livestock industry as distinct from the production of cereals, pulses, oilseeds, sugar, cotton and other products of arable agriculture.

Livestock as a cottage industry

The great advantage of the livestock industry, as practised in this country, over manufacturing industries, is that it is practised as a cottage industry. Since it is rarely carried on in cities but is distributed all over the country, housing difficulties for the workers, leading to the growth of slums and other public health problems, do not arise. Since it can be carried on with little capital, there is no difficulty in starting or practising any one of its branches. Regarding the sale of the products of this enterprise, there is no necessity to have any expensive selling agency as they are all articles of daily necessity in every household and the small producer can dispose of his goods in his own neighbourhood without the intervention of a middleman. Nevertheless, animal husbandry can be easily converted into an extensive and specialized industry, if so desired.

Fundamental importance

Indian agriculture is entirely dependent upon bullock labour for the cultivation of the land and almost entirely for the transport of produce to market as well as from village to village. As the Royal Commission on Agriculture pointed out: 'In most parts of the world cattle are valued for food and milk; in India their primary importance is draught for the plough or the cart... Without the ox no cultivation would be possible; without the ox no produce could be transported.' In this country, there is little likelihood of motor traction replacing bullock labour to any appreciable extent on the farm for many years to come; hence with agriculture entirely dependent on the draught bullock, the fundamental importance of the cattle industry in our national economy becomes obvious.

The animal wealth of India, as measured by the numbers of its livestock, is enormous.

To quote the Royal Commission on Agriculture again, 'in whatever respect Indian cattle may be lacking, they do not lack numbers'. We have within our borders about 215 million head of cattle, 54 million goats, 43·5 million sheep, 4·5 million horses and well over a million camels. In addition to the above there are about 243 million poultry. Figures are not available for the pig population, but it can be presumed that they too will number some millions.

One-third of world's cattle

From the above figures it is evident that the livestock population of India is composed predominantly of cattle. There are in this country roughly a third of the world's cattle or as many as are present in the whole of Australia, New Zealand, North America and Europe (excluding Russia) put together.

The 43·5 million sheep in India equal roughly half the sheep population of Australia or about the same as that of the U. S. A., Argentina or South Africa. Indian goats constitute nearly a quarter of the number of these animals in the world. We have, however, only a small population of equines compared with many other countries. Camels form only a small proportion of the livestock of India.

The number of fowls in India is about 173 millions, that is more than three times as many as in Canada or Japan, 2·5 times as many as in Great Britain, seven times as many as in the Netherlands and eight times as many as in Denmark. The U. S. A., however, has two and a half times the present number in India. Thus it is apparent that this country ranks very high even among the poultry-producing countries of the world.

The above numbers of the different classes of livestock are sufficiently arresting to indicate the extent of the economic assets, actual as well as potential, that we possess in our farm stock and the part played by this industry in the national economy.

Value of livestock industry

No attempt seems to have been made to estimate the capital value of these millions of farm stock, perhaps owing to the extreme difficulty of assigning average values to the widely varying quality of the animals concerned as well as to the ever-changing nature of these figures in world markets.

But the value of their contribution to the agricultural produce of the land has been assessed and has been found to run to hundreds of crores of rupees a year. It must be stated at the outset that there are great variations in the monetary values arrived at by different authorities, which is but natural, as the prices are fluctuating, and for some of the items there is no fixed standard by which reasonably accurate values can be obtained. However, the figures can be taken as indicating the magnitude of the contribution of farm stock to the national wealth and will serve to put them in their proper perspective when compared with other great sources of national income.

The most important contribution of our livestock to agriculture is in the shape of bullock labour for ploughing the land and transporting its produce. It is extremely difficult to assess the monetary value of this unique service with any great degree of precision. It has, however, been estimated at about Rs. 500 crores per annum.

Only next in importance to the labour contribution is the value of the milk produced. A recent survey estimates the annual production at about 800 million maunds worth about Rs. 300 crores. This is equal to the value of all the rice grown in India or four times that of all the wheat raised.

Another direct source of income derived from livestock, the actual monetary equivalent of which is also most difficult to assess, is their contribution to the fertility of the land in the shape of manure. A rough estimate of the cash value of this item places it at about Rs. 270 crores annually, that is very nearly the value of the total milk production and about three times the normal annual revenue of the Government of India.

The value of meat consumed as beef and mutton has been estimated to be about Rs. 20 crores per annum. The price of eggs and table poultry has been valued at about Rs. 13 crores. So these products, which represent animal foods derived from farm stock, excluding pigs, approximate to only

11 per cent of the value of the milk produced.

Miscellaneous products such as hides and skins, offals, bones, etc. are other important sources of income from livestock. India is, in fact, the largest exporter of hides and skins in the British Empire, her products representing a third of the total Empire exports. The annual output of this group of products is valued at Rs. 40 crores. Even this minor by-product of cattle industry has a greater monetary value than the total Indian output of sugar which is valued at about Rs. 30 crores.

The wool derived from sheep, amounting to roughly 100 million pounds in weight, has been valued at about Rs. 3 crores. In addition to the above, the value of milk produced by goats, the work performed by horses, mules, donkeys and camels, as well as the pork produced by swine, go to swell the figure representing the contribution of livestock to the wealth of the country. The sum of these items amounts to over Rs. 1,200 crores per annum, which is somewhat larger than the total value of all the products of Indian arable farming.

India's backwardness

To get a proper perspective of the real state of affairs of our livestock industry, we should compare it with that in other countries of the world. This will open our eyes to the fact that, in spite of the immense value of the contribution of our farm animals to our national wealth, we have every reason to be perturbed at the pitiably low level of efficiency that every single phase of the industry reveals. In not a single item have we any reason even for remote satisfaction, much less for pride.

Egypt is a country using cattle for the plough and having a system of agriculture more or less similar to that of the irrigated tracts of India, excepting that the practice there may be said to be a little more intensive. Even with this handicap, the Egyptian fellaheen uses only about three animals to do the work of 22 in India. This one contrast is sufficiently expressive of the gross inefficiency of our work cattle to cause us serious thought.

Regarding milk production, we have ample data to show that, whereas India has a larger cattle population than any other country in the world, her *per capita* production of milk is the lowest on record. While the average annual production of milk per head of cattle in Denmark is 387, in Switzerland 380, in the Netherlands 373, in Belgium 362, in Finland 344 and in Sweden 326 gallons, in India it is less than 30 gallons. Denmark, with only 1/70th of the number of cattle, produces about a fifth of India's output of milk, showing 14 times greater efficiency. India produces only 60 per cent of the milk output of the U. S. A. in spite of the fact that we have over three and half times the number of cattle. Even in the matter of meat and wool production, the position is scarcely better, and this applies equally to the realized value of the hides and skins.

Whereas in other countries cattle manure is fully returned to the soil, thus replenishing losses and bringing about improvement, in India the major part is burnt as fuel even though the land is continually being drained of its vital nourishment by continuous cropping, which impoverishes the soil and reduces the yield.

The position is no better in the poultry industry. In spite of our advantage in numbers, our position as a producer of eggs or of table poultry is on a par with our milk production. The U. S. A., with $3\frac{1}{2}$ times the number of birds, produces nearly 11 times the number of eggs and Denmark, with only about an eighth of the number, produces nearly three-fourths the number of eggs. The annual egg production per bird is 130 in Japan, 125 in the Netherlands and 120 in Denmark, Eire and Great Britain, while it is only 54 in India.

Causes of low efficiency

The reasons for this inefficient and uneconomic production of our livestock are many and varied. Among the most important are the absence of any breeding policy, under- and malnutrition, disease infestation, over-population, religious prejudices, the dietetic habits of the people, the extreme poverty of Indian farmers, a lack of popular interest owing to inadequate propaganda and a veterinary

organization wholly out of proportion to the vast size of the country and the problems with which it has to deal.

Without a sustained policy of rigid selection and pedigree breeding, even the best livestock are bound to deteriorate in time. When we remember that in this country such practices are unknown to the average husbandman, it is little wonder that the breeds of cattle and other stock are in a shocking condition.

The provision of adequate and proper nourishment is the foundation on which the health and efficiency of all living creatures depend and farm animals are no exception to this rule. Malnutrition, in the widest sense, is perhaps the greatest factor in the causation, development and continued existence of the inefficiency of Indian livestock. Pasture, which is the natural food of cattle, is not available all the year round owing to climatic, economic and other reasons. The vast areas of forests where grass is obtainable in plenty during most of the year, are available only to a small fraction of the total cattle population owing to their geographic distribution. Hence the majority of animals have to crowd on to the scattered waste lands, canal banks, *bunds* and stubbly fields. Owing to the pressure on the land caused by the increasing human population, even the waste lands are being steadily brought under the plough. In spite of the magnitude of the livestock population, the area under purely fodder cultivation is negligible. It constitutes hardly 5 per cent of that under cereals, pulses and other crops raised for human requirements, though there are only 25 per cent less animals than humans.

The cereal and pulse straws, grain residues, oil-cakes and other by-products of human food crops are available for cattle feeding, but the amount is quite inadequate. If we suppose that all the sheep, goats, horses, mules, donkeys, camels and other stock, numbering over a hundred millions, are not fed any of the by-products mentioned above or of the other cultivated fodder crops raised and that all these materials are employed to feed only the cattle, then they will obtain, per head, 4·4 lb. of dry fodder supplying only 0·1 lb. of digestible protein and 2·3 lb. of total digestible nutrients. According to estimated standards, their optimum requirements are 10 lb. of dry fodder containing 0·8 lb. of digestible protein and 6·0 lb. of total digestible nutrients per head for healthy functioning and efficient production. Admittedly, it is unlikely that this deficiency in nutrients will be made up from the poor grazing available to the average animal.

The cumulative effect of this systematic underfeeding is the progressive deterioration in health and efficiency of the animals. Though the effects manifest themselves only gradually, they are of very great danger to national prosperity as they undermine the very foundations of our livestock industry. The deterioration is not confined to individuals only but also extends to their progeny, thus causing a long-range drop in efficiency of incalculable magnitude. The underfed bullock is unable to perform work satisfactorily, the semi-starved bull is incapable of producing strong and virile progeny and the ill-nourished cow gives but little milk. Besides the loss in milk yield, the cow under such conditions of malnutrition does not breed properly or regularly, often brings forth weak and sickly or dead calves and thus causes a further deterioration of the stock, thwarting the efforts of the systematic breeder. All these underfed animals fall easy victims to the ravages of disease and this causes further expense and loss.

Owing to the religious beliefs and dietetic habits of the people, the superfluous and inefficient animals, which in other countries would have been slaughtered and used for food, have also to be maintained till they die naturally. To provide for the losses due to disease, the farmer has to keep far more stock than he wants or for which he can provide, thus adding to the overcrowding and putting a greater strain than ever on the inadequate food resources available.

Prospects of improvement

That there is urgent necessity for improving the efficiency of work cattle and for increasing the production of cows, goats, sheep, fowls, etc. must now be obvious. The question naturally arises whether there are reasonable prospects

of successfully effecting these improvements and if so what are the steps to be taken for their realization.

We have in India some excellent breeds of cattle suitable for work, milk or general purposes such as the Amrit-Mahal, Kangayam, Sindhi, Tharparkar, Sahiwal, Hariana and Ongole whose intrinsic efficiency and productive capacity have been amply proved and which, if bred, fed and managed with proper care and attention, would prove as good as any cattle in the world. The famous Kashmir wools which even now we so highly prize are evidence of the latent potentialities of our sheep and goats awaiting systematic development. Regarding fowls, recent trials have indicated potentialities for improved production as is found among cattle. There is no doubt that this applies also to all other classes of farm stock.

At one time India was an exporter of cattle to different parts of the world. The famous Ongole cattle were exported to places as far apart as Brazil and the Philippines and there was a brisk trade going on which has been assessed at about 36 lakhs of rupees annually. This has now entirely disappeared, but could be revived and expanded if proper steps were taken. It has been stated that 'if animal breeding in the tropical empire followed a more closely unified policy and there were greater contacts between India and the colonies, it should be possible for India to be the stud farm of the tropics'.

Furthermore, we had, even so recently as some ten years ago, an export trade in dairy produce, mostly ghee, to the extent of about Rs. 36 lakhs per annum which has now been reduced to negligible proportions, while there is a rapidly growing import of these products. When we remember that we have a third of the world's cattle in India, and yet produce and consume less than 8 oz. of milk per head of population per day, the necessity and urgency for improvement becomes obvious.

Remedial measures

The methods necessary for effecting improvement may be broadly classified as those pertaining to breeding, feeding and disease control. In the improvement of livestock, it is accepted that the ultimate level of efficiency is determined by inherited characteristics when every other factor is at its optimum level. Hence, with a mongrel animal, it is no use hoping for spectacular results even though it be fed and managed with the utmost care and attention. However, as already stated, we suffer from no lack of efficient breeds. The innate efficiency of Indian livestock has been amply demonstrated. The milk yield of some of the properly managed dairy herds has been doubled and even trebled within about a couple of decades, a result which has been obtained only after a much longer period in foreign countries.

Though breeding lays down the limits of productive efficiency, the function of proper nutrition in attaining and maintaining these levels is of fundamental importance.

Importance of nutrition

The effects of under- and malnutrition in undermining the health and efficiency of farm stock has already been pointed out. Since the effects of malnutrition generally manifest themselves slowly, it never receives in time the attention it deserves. But knowing its widespread prevalence and also realizing its potent destructive effects, it is incumbent on us to tackle immediately the vital problem of providing adequate nutrition for all farm animals. This can be done by the improvement, conservation and proper utilization of all pasture lands by suitable methods of manuring, *bunding*, fencing, etc., by extending the cultivation of leguminous and other protein-rich fodder crops, by adopting effective and systematic methods of preventing wastage of forest grasses by converting them into silage or hay, by retaining the ingredients for oil-cakes by exporting oils instead of oilseeds and adopting other similar measures for increasing, improving and conserving all the fodder resources of the country.

The control of disease is of no less importance than the adoption of the above measures. The havoc caused by bacterial, virus, protozoan, helminthic and other forms of disease is too well known to need description. Besides the direct loss through death and the decreased efficiency of the animals themselves, the

danger to public health arising from diseases communicable to man such as tuberculosis, anthrax, glanders, tetanus and undulant fever is of such magnitude that all other countries have taken stringent measures to control them. Intensive measures to combat all diseases have to be taken, and in this the closest co-operation between human and veterinary medicine is essential.

Means to an end

The main object of agriculture is the production of material for human food and clothing and in this respect the livestock industry and arable agriculture share the honours equally. Hence animals have to be looked upon as a means to an end rather than an end in themselves. It has often been stated by eminent authorities that the success of agriculture and animal husbandry in India is dependent to a great extent upon mixed farming. The cultivator should keep only the minimum number of livestock he requires or those he can feed and manage efficiently. He should try to grow on his farm, as far as possible, all the fodder requirements of his stock. He should be enjoined to provide some green fodder, especially legumes, for his milking and growing stock all the year round. He must be able to supply ample food of the right quality to his animals. Whenever possible, green fodder should be conserved as silage or hay. No manure should be burnt but it should all be returned to the soil. Stock should be bred with only approved pedigree stud animals. All domesticated animals should be inoculated against preventable diseases and, where possible, the necessary facilities for this should be provided free or at a nominal cost.

Scientific researches into all the problems concerning livestock should be widely carried out and, even more important, the results achieved in the laboratory should be passed on to the peasant in a cheap and practical form. He should be persuaded to adopt them by visual demonstrations and by systematic and sustained propaganda.

New ideas and methods of organization are required to bring into actual practice the very many improvements necessary to increase the efficiency of the livestock industry. The success of this enterprise will ensure the greater prosperity of the husbandman and the better health of the whole nation.

THE LUCKNOW COOPERATIVE MILK SUPPLY UNION

By W. L. Davies, Ph.D., D.Sc., F.I.C., N.D.A.*
Director of Dairy Research, Government of India

Among many steps in the development of India's dairy industry, two simple forms of progress consist of increasing the consumption of milk in urban areas and the organization of rural supplies to satisfy such a demand. The urban population would benefit in many ways if a constant supply of safe milk of uniform quality and reasonable price were available. The small rural producer would benefit from a regular and fair market for his milk. Above all, the cost of collecting, processing, transport and the distribution of such milk would be pared down to a minimum. This can be done only by careful management of all steps, and the maintenance of economic units for working; this has been done by uniting the producers cooperatively, taking advantage of geographical features for collection and transport, and maintaining a satisfied retail market.

Marketing of indigenous milk products

(*a*) *Transport factors.*—It can be realized at once that the form of milk product marketed from a certain producing area depends on the distance to the market. In places where there is no organized marketing, it can be said that cultivators up to 12 miles from a city will take their milk for sale in the city, using headloads, bicycles, light horse-drawn vehicles or rail for transport. The extended use of the bicycle has increased this radius to about 20 miles in some places. Farther afield, up to 40 miles, *khoa* and some ghee will be the primary dairy products, whilst at distances over 40 miles the main, and perhaps the only, sale product is ghee. Of greatest importance is the time factor in transport and its effect on the product. The product must not lose part or all of its marketable value during the time it takes to travel between producer and consumer. The effect of this factor is accentuated in India owing to high atmospheric temperatures during the day almost throughout the year.

(*b*) *Effect of development of processing and transport methods.*—It is obvious that improvements in methods of production, processing and transport will safeguard the marketable value of liquid milk. These improvements are of world-wide application and have been called for by the demand for uniform supplies of milk in large consuming centres. It must, however, be realized that these improvements have been attended by a considerable rise in the retail price of milk. The question in India, as in all other countries, is to work in such a way that this extra cost is spread over the quantity of milk found most economic to handle. With new ventures of this kind in India, capital expenditure on plant and other requirements must be small, the innovations must be brought in gradually and all the steps in the process must be as simple as possible. This progress has been achieved in a few places in India.

The new developments in dairying and their effects in such milk marketing ventures may be enumerated as follows:

(*a*) The producer is helped to maintain productive animals.

(*b*) He is helped to feed these animals rationally.

(*c*) He is encouraged to produce milk in a hygienic manner.

(*d*) The bulked milk from many villages is collected at a convenient centre or centres on a *pukka* road.

(*e*) The amount collected is sufficient to warrant the use of a small motor lorry for transport (the lorry may collect from many centres on the road).

(*f*) The milk is processed either at the

* We regret to announce the death of Dr Davies in New Delhi on 15 May after a brief illness. An obituary notice will appear in our next issue.—Ed.

collecting or the distributing centre so as to enable it to gain in keeping quality.

(*g*) There are facilities at the distributing centre to cool the milk and to keep it in cold storage until ready for retail.

These arrangements involve considerable capital expenditure to start the scheme and also entail considerable running costs.

Lucknow Cooperative Milk Supply Union

With the above requirements of cooperative milk handling in view, it is interesting to trace how a successful milk supply union has overcome its various problems. The Lucknow Union can very well be selected as an example.

In the districts around Lucknow in which the Union is now active a considerable number of cooperative credit societies were in existence. These societies, however, were not successful and the members were slowly getting deeper into debt. Villages served by canal irrigation were more successful than those dependent only on the rains for success in cropping. Most of the cultivators produced milk which they sold at low prices to *halwais*. Undoubtedly there was considerable exploitation of the milk trade by middlemen and the *halwai* purchasers.

System of indigenous milk marketing

The system of milk marketing by the *halwais* is worth describing. The *halwais* in the city advanced money to cattle owners without interest and assured themselves of a regular milk supply by working on the following conditions: (*a*) the rate of supply of milk varied from 14 to 16 seers per rupee, the seer measure being 20 chataks; (*b*) the *khoa* yield of the milk supplied to be four chataks per seer; (*c*) if the *khoa* yield was less than four chataks the milk volume had to be increased proportionately. This system was very unsatisfactory. The milk supplier had to spend much time at the *halwai's* shop while the tests for *khoa* yield were carried out. In spite of the strict terms of contract, the purchasers defrauded the producer in the weighing of the milk, and the milk was over-evaporated in order to reduce the *khoa* yield. The accounts were never settled and advances were made from time to time on demand by the producers. If the producers gave up the contract, either they did not recover the money due to them or numerous difficulties were placed in the way of its recovery.

Effect on the milking stock

The milk producers did not get sufficient returns to enable them to maintain their animals on satisfactory rations. The animals were allowed only rough grazing supplemented by coarse crop residues (toppings of sugarcane, *arhar* and *chana*, and various straws). The class of milch animal slowly deteriorated, the yield falling below two seers a day. It is evident that under these conditions the position of the milk producers was progressively deteriorating.

Deterioration arrested

This is where the Cooperative Supply Union stepped in to improve matters. The first step was to take a census of milch animals in the villages and to make a survey of the methods of marketing milk and its products. From this survey the drawbacks of the indigenous method of marketing just described were realized.

The first constructive step taken was to improve the type of milch animal in the village. This was done by buying out of cooperative grants animals from the Rohtak district (Punjab), interest on the cost of the animals being charged at 9 per cent per annum. In the first and second years Murrah buffaloes and some Hariana cows costing Rs. 14,000 were bought and distributed to the various villages in the circles.

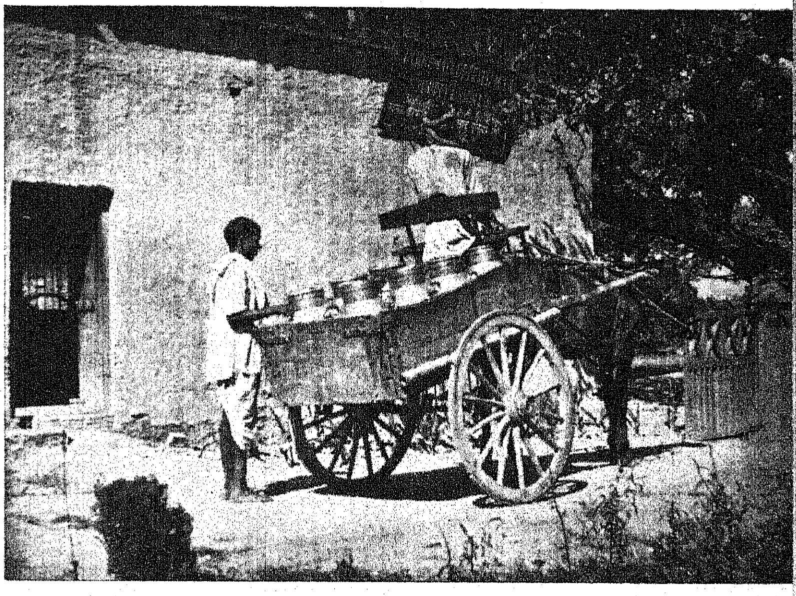
The animals were purchased in the Rohtak cattle market in the presence of all the interests concerned. A party of one representative from each village headed by a supervisor made a selection of the animals; in this they were helped by the local cattle-breeding Inspector. Steps have been taken to supply improved bulls. These bulls are not maintained by the village societies nor are any contributions made by the societies for their maintenance. The Milk Union bears the whole cost of their upkeep. They are placed in the charge of a member of a society who is paid the cost of their maintenance by the Union.

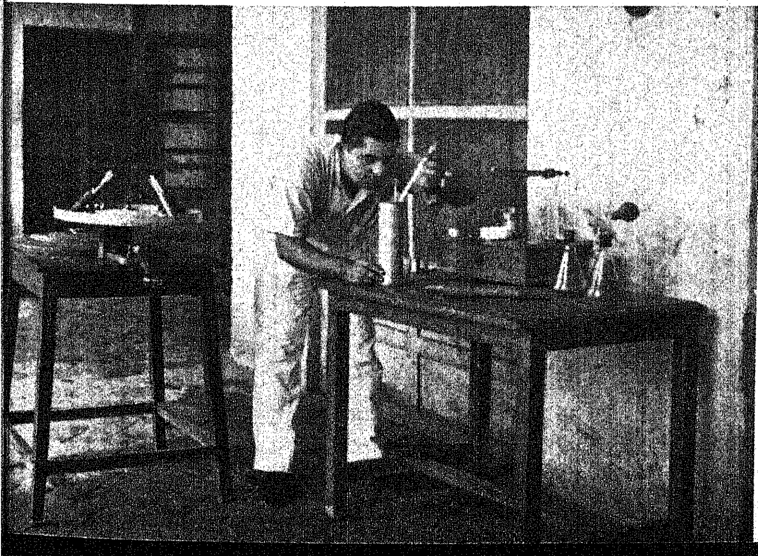
Organization of the village society

The unit of production is the village society. The bulked milk of this society is taken to the

Left : Measuring and recording the milk of each village producer

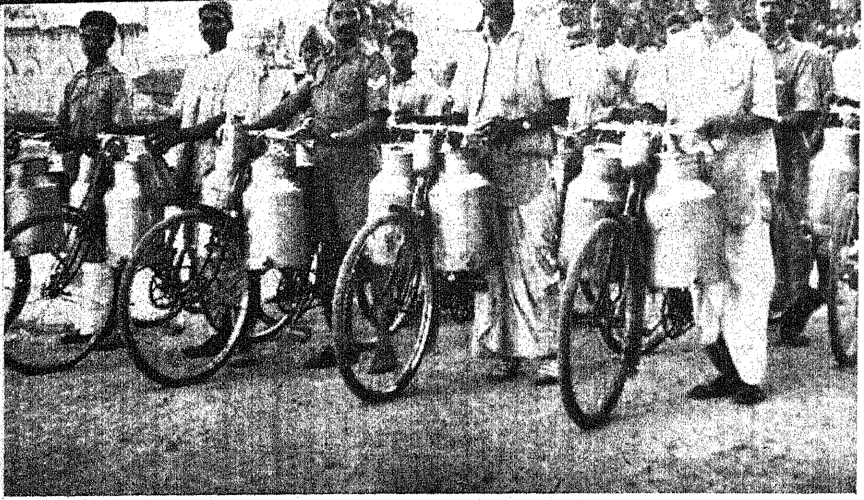
Right : Transfer of milk by tonga to urban centre



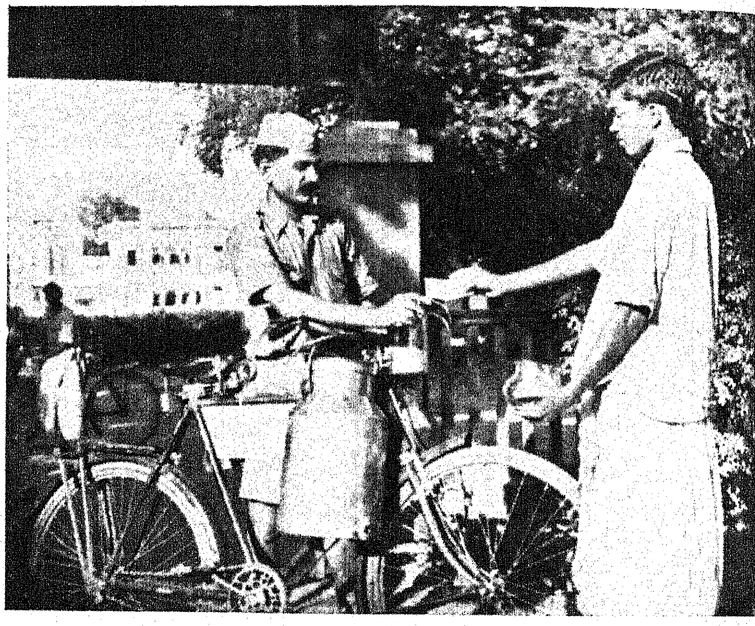


Left : Determination of fat and total solids in milk for control of quality

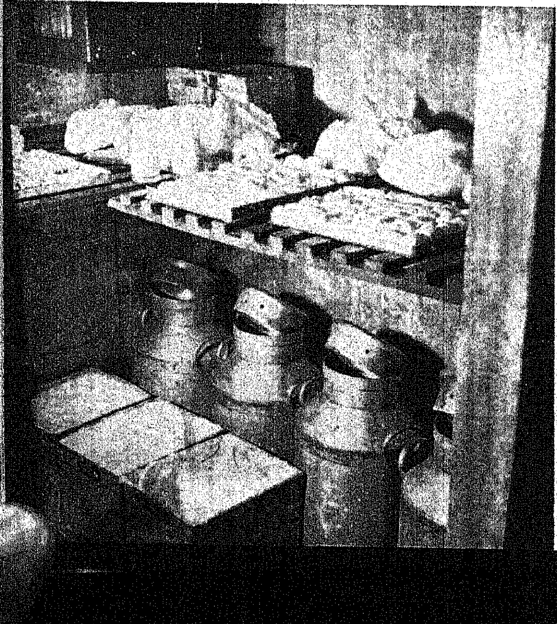
[PLATE 86



Left : Carriers setting out to deliver milk



Right : Salesman receiving coupon from a customer



Left : Dairy products in cold storage before sale

collecting centre; the only check made is to see that the amount delivered at the collecting centre is the same as the amount sent from the village. The village society thus has to manage its own affairs in respect of (*a*) collecting the milch animals at a convenient centre for milking under supervision, (*b*) the weighing of the produce from each small producer, (*c*) the bulking of the milk, the locking of cans and the transport of milk to the collecting centre, (*d*) the payment to each producer for his milk, and (*e*) the buying of concentrated food from the parent society and its distribution among the villagers. To carry out these duties a village committee, such as a panchayat, is formed.

The animals are collected at a convenient spot and milked. The producer brings the bucket of milk to the platform where the panchayat sits, the milk is measured by the *carrier* in the presence of the producer and the weight is entered in the producer's passbook and in the society's register. The first page of every passbook used to contain a history of the animals and a record of the daily milk yield, which was checked by the society's register; at present these records are entered only in the society's register. The carrier who transports the milk to the collecting centre does the measuring and bulking of the society's milk; he is responsible for the safe transport of the milk without loss or adulteration and is a paid member of the village society. The society also pays a monthly allowance to its member-secretary for the keeping of accounts and records.

Transport to the collecting centre

The milk is bulked in cans holding 20 seers; these are made locally for about Rs. 5. The cans are locked; one key remains in the village; the other is kept at the collecting centre. The milk is transported to the collecting centre by the most convenient method, e.g. by headload, bicycle, pony or tonga, depending on the state of the roads, season, distance, etc. Since the milk has not been treated in any way at the village, this distance is covered as rapidly as possible.

On reaching the collecting centre, the milk cans are opened, a sample of the milk is taken and the weight of the milk is checked not by actual weighing but by volume, using vessels of multiples and submultiples of a seer. The amount of milk from each village is entered in a register and checked with the amount entered in the village register. The produce from the villages supplying the centre is then bulked into large churns holding one maund of milk, in which the milk is transported to the city distributing centre.

Transport to city centre

It has to be decided at the collecting centre whether the unprocessed milk from the villages will have to be processed before it is sent to the city. This depends on the length of time from milking until delivery in the city and the temperature of the milk and the air; the volume of milk collected is another important factor in determining what to do. In a small collecting centre a certain volume of milk may be considered as an economic unit when capital and running costs are concerned. Too small a volume means a high running cost per maund; too large a volume means either a lengthy processing period or too high an initial capital expenditure.

If a good road is available for motor transport the milk may with safety be carried unprocessed to the city. On the other hand a form of heat treatment may be demanded. This is best done by heating the cans of milk in larger vessels of boiling water until the whole of the milk reaches a temperature of 165°F. The milk is not cooled but is immediately covered and sealed and transported to the city centre.

Treatment at the city centre

If the milk has not been previously processed, it must be pasteurized and cooled at the city centre. This is done by the *flash* method of heating to 165°F. by the cheapest possible means and then cooling down to 40-45°F. and storing in a cold chamber until ready for distribution. Milk which has been transported in a hot condition from the collecting centre is cooled and kept in cold storage.

The cost of distribution must be kept down to a minimum. It has to be realized that processing and distribution are the two steps which are responsible for the high retail price

of milk as compared with the price paid for the raw milk. The milk of the Lucknow Society is distributed loose from cans carried on bicycles. To detect and prevent adulteration by adding water, the milk of any distributor may be sampled in the street at any time without warning.

Main difficulties

The above is a detailed description of the steps taken by the Lucknow Cooperative Milk Supply Union to organize village milk production, and the transport and handling of the milk from producer to consumer. The Society has been working for over three years, and although it has overcome many problems connected with the organization of the Union, it has still to face many practical difficulties which are concerned both with milk as a perishable article and as an article of food in a competitive market.

The difficulties on the technical side are concerned with safeguarding the keeping quality of milk in the cheapest possible manner. The Union has to sell a product reputed to have a good quality in competition with the fragmentary sale of an inferior product by *gowalas*. The profit of the Union's working rests almost entirely on paring down transport and processing costs to a minimum. Whether the milk should be heat-treated at the collecting centre or at the city centre depends largely on seasonal and local conditions. It is a good practice always to cool milk as soon as possible after milking. Owing to conditions in villages, it is difficult sometimes to get water at all, much less enough cold water for cooling.

The Union has done much teaching of how to prepare the animal for milking and to milk by hygienic methods. The villager is proud to maintain this hygienic discipline and the quality of milk has been greatly improved by it. The cans are scrupulously cleaned at the centres so as to ensure their being in the best condition to receive the milk.

Tests for fat and total solids are regularly carried out. Some data on the effect of air temperature on that of the milk have been collected but more comprehensive data covering all seasons are required. Some trouble in carrying milk in a hot condition may be met with as there are some lactic acid-producing bacteria which thrive at 140-150°F.; these, however, have not caused trouble so far.

The main problem is to popularize this class of milk among the public so as to promote increased sales. It is to be feared that urban populations are either not milk-conscious or not quality-conscious where foodstuffs, especially dairy products, are concerned. Competition from the *gowala*, with his frequently adulterated milk, would be overcome gradually if the buying public were educated sufficiently to discern this difference of quality. Another method is to attract customers by giving other services, such as supplying cream, butter and ghee. The scheme has the full support of educational, health and other public services irrespective of personal bias, since the venture is a non-profit-making business and a genuine attempt at eliminating that agent in milk marketing whose sole interest is profit, namely the middleman.

Other difficulties

Owing to high capital expenditure some villages are without a good water supply or a covered milking shed. A shed with *pukka* floor and clean surroundings would help greatly in clean milk production since one of the chief ways in which milk is contaminated is by dust from the air.

The Union insists on some milk being left in the villages so as not to deprive the inhabitants, especially children, of this protective food. At least half a seer of milk per family is retained together with the fractions of half a seer which are not included in the bulked village milk. Young calves are also cared for from birth with regard to their milk and other rations.

Difficulties connected with the proper rationing of milking animals have been overcome by the purchase of concentrated foods by the parent society and their distribution according to the needs of each village society. This wholesale buying cuts down the feeding costs greatly. The inspector instructs the producers in rationing according to yield, and after preliminary instruction, the rationing is left to the village committee. The concentrated foods are paid for in instalments out of the

receipts for milk. Grazing facilities are better arranged on a cooperative basis. Stores of rough fodder are also bought in large quantities and distributed. The societies also have the advantage of advice and inspection by the official veterinary staffs.

Progress of the Lucknow Union

This experiment of mutual help was carried on at the beginning through the credit societies mentioned; the main idea then was to make these societies solvent again. That was the aim of organizing the production and sale of milk.

The societies were then advanced Rs. 7,000 by the District Cooperative Bank, Ltd., Lucknow, at 9 per cent for the purchase of milch cattle. A loan of Rs. 100 without interest was advanced from the Rural Reconstruction Fund drawn from the Sugarcane Commission Funds; this sum was invested in cans, measures, etc. The purchase of concentrates is made from the money deposited by members in their compulsory thrift accounts (1 anna per rupee from sale proceeds).

Substantial help was then received from Government which gave Rs. 20,000 for the purchase of machinery and equipment, Rs. 5,000 for a motor van and Rs. 5,400* for the construction of wells and milking sheds in some villages. Some of these funds have been used for the purposes intended with the result that the safeguarding of milk quality at least is well provided for. The financial position of the Union at present is unfortunately not strong, but every effort is made to run the Union on business lines, and the making of profits will take time.

Quantities handled

The following statement gives the amounts handled in the years 1938-39 and 1939-40:

	1938-39	1939-40
Total milk handled (md.)	5,663	11,450
Daily supply (md.)	15½	31¼
Sold as liquid milk (md.)	4,182	9,205
Separated into cream (md.)	1,483	1,835
No. of families supplied	500	800
Educational Institutions supplied	..	22
Price of milk (seers to the rupee)	7½	7-7½
Receipts for milk (Rs.)	16,098	50,969
Ghee (from surplus cream) (lb.)	1,000	2,296
Sale proceeds from ghee (Rs.)	662	1,404
Butter made (lb.)	1,000	4,661
Sale proceeds from butter (Rs.)	876	3,410
No. of village societies of all classes	40	79

* This loan has not up to the present been utilized.

The ghee was sold at 12 chataks to the rupee and the butter at 12 annas per lb. The present rate for ghee is 10¾ chataks to the rupee and for butter 14 annas per lb.

It can be seen that the Union made great progress in 1939-40 when it more than doubled the amount of milk handled, with parallel increases in the amounts of almost all milk products.

Profits and losses

The Union was registered in March 1938. In the period up to June 1938 it worked at a small loss of Rs. 210. The year July 1938—June 1939 was worked at a profit of Rs. 1,035. Unfortunately in 1939-40 there was a loss of Rs. 5,035. This loss is made up mostly of rail carriage of milch animals from the Punjab, upkeep of dry animals and irrecoverable debts and one-third the cost of construction of milking sheds and wells in villages. Other measures aiming at the improvement of the condition of villagers have been the cause of some unremunerative expenditure.

Ways have been devised to improve the financial position. Supplies of milk are now drawn from more compact areas so as to reduce the cost of transport. The services of two wholetime supervisors to attend exclusively to milk have been obtained. One out of three collecting centres which was working at a loss has been closed down and the other two centres now cover more compact areas supplying a larger volume of milk. Also, recurring expenditure on removal to, and the buying of new plant for, a new building will not have to be faced in future years.

An attempt has been made in this article to describe the problems which arise in securing milk from villages to supply concentrated urban populations, the working of the Lucknow Union being taken as an example of how this has been achieved. The scheme involves more than working for monetary profit; it embraces ideals which will yield a benefit only after a number of years. The movement educates the villager in milk and personal hygiene, thirft and a pride in his occupation; it brings the principles of fair dealing and honesty into his daily life; the work of milk production is made more worth while. The

consumer is also provided with a better and safer article of food at a competitive price and the slowly moving educative effect of a uniform product and of example will slowly raise the demand for wholesome milk in urban areas. The villager is prevented from starving himself of milk by insisting on residues being kept for the family. The work of disposing of his milk is taken from his hands by those he has learned to trust; he can therefore spend more time on his farm attending to his crops and animals.

There are many problems connected with this work which have not been mentioned here. They are concerned mostly with the exploitation of the villagers' milk at places remote from towns, such as the manufacture and marketing of *khoa* and ghee; yield and quality mean much here. Then there is the disposal of surplus milk and of separated milk in the most profitable manner and of the improvement of milking stock generally.

The author is indebted to Rai Saheb Gopai Lal, Honorary Secretary of the Union and Mr N. K. Bhargava, I.D.D., for their kind services in providing material for this article, and in association with Messrs G. W. Lawrie & Co., Lucknow, for the photographs illustrating the activities of the Union.

MODERN PROBLEMS DEMAND RESEARCH ORGANIZATION

THE laboratory which functions within the Bell Telephone System comprises about 4,500 employees, one-half of whom are skilled scientific workers and technicians, while the remainder include laboratory assistants and the necessary service groups of various sorts. Experience speaks so strongly that today no verbal argument is needed to justify the existence of such a centralized research and development organization.

But it becomes increasingly apparent every day that problems of so complex a nature as to demand organized attack are not peculiar to industry. Problems of this calibre are indeed becoming more and more the substratum of our daily lives and in increased proportion as we base our livelihoods upon the closely inter-related routines demanded by an industrialized society, and as we augment human effort at every turn with the facilities of the machine, as well as the involved chemical and physical processes which Nature has placed at our disposal. In the face of our growing involvement in the results of our own activity, our choice must either be to run the risk of temporizing, or to undertake purposively to improve our organizational forms with the aid of which we may entertain a reasonable hope of matching our analytical powers to our problems as they grow in intricacy. From *Engineering Progress and the Social Order* by F. B. Jewett and R. W. King, *Nature*, 28 December 1940.

DISPOSAL OF MOLASSES AND SUGAR FACTORY EFFLUENTS

By H. D. Sen, M.Sc., Ph.D. (Lond.), D.I.C.

Biochemist, Imperial Institute of Sugar Technology, Cawnpore

Molasses constitutes one of the main by-products of the sugar industry and is being produced in considerable quantities at the sugar factories in India. The yield varies from 3·5 to 4 per cent on the weight of cane and it is computed that the yearly production of molasses from the 150 sugar factories amounts to around 500,000 tons.

It is desirable that this waste product should be utilized in the most economical manner and the efforts of the biochemists have been directed towards discovering suitable outlets which will be profitable to the sugar factories.

The normal market price of molasses before the present war ranged between $1\frac{1}{2}$ and 2 annas per maund, but a rise in value has subsequently taken place. It is to be expected that after the war conditions will return to normal and that the price will not rise above 4 as. per maund of molasses. For calculation purposes this latter figure may be taken as maximum.

Products of molasses

Molasses is known to give valuable solvents —alcohols, ethyl, propyl, butyl; acetone, acetic, lactic, citric, and gluconic acids, glycerine, yeast and a number of other products. Some of these are the bases in the manufacture of fine chemicals, pharmaceuticals and food products, explosives, synthetic rubber and rayon.

Of the varied researches undertaken on molasses in the biochemical laboratories of the Imperial Institute of Sugar Technology only those which have given tangible results and passed through the semi-large-scale tests for many years are described here with explanation of the newly worked-out processes and details of working semi-large-scale plants.

Sugar factory effluents

Sugar factory effluents form a constant source of nuisance as one can realize from the unpleasant smell that invariably pervades the sugar factory precincts. The problem, therefore, requires immediate consideration. The endeavour to minimize the nuisance by addition of such chemicals as lime, bleaching powder, etc. was found to have temporary effect. It was established by continued research that a preliminary fermentation of the effluent was a necessary step for a permanent remedy of the nuisance.

Srivastava and Sen system

The process is simple and economic and consists of preliminary settling and separation of the coarser particles. The effluent water coming through a strainer runs down the main exit drain into a sump where it settles for some time, the lighter impurities being removed from the top and heavier impurities occasionally removed during cleaning periods.

The partially purified effluent is then taken into the fermentation tanks. Here it is subjected to bacterial oxidation, the bacteria being obtained by the self-fermentation of saccharine products collected as black sludge at the bottom of the condenser water tanks. This acts as a good starter. In order to accelerate the process of fermentation, the liquid in the tank is vigorously aerated by means of a blower or air compressor, which produces rapid circulation and brings the organisms into intimate contact with the effluent. Eight hours aeration is quite sufficient to bring down the oxygen absorbed value from 65 to 70 parts to about 5 to 11 parts per 100,000 parts.

After the bacterial oxidation is complete, the organic impurities, though decomposed,

remain in a colloidal condition and require treatment with milk of lime in a separate tank, termed chemical treatment tank. With the neutralization of the acidity the liquid cracks and a heavy sediment separates, leaving the liquid clear and inodorous.

There are still some residual organic impurities left, and they are removed by adding a solution of potassium permanganate, which eventually brings down the oxygen absorbed value within permissible limits (4 parts in 100,000 parts), satisfying the Public Health requirements.

The separation of the sludge is effected by settling and decantation by passing the treated water through baffles.

Estimate of capital cost

The capital cost of making masonry tanks, air compressor, pumps and aerating pipelines works out to Rs. 100 per 1,000 gallons effluent per day capacity and running expenses at 4 as. for treating 1,000 gallons effluent.

Capital cost for a 600 ton factory

	Rs.
Masonry work in tanks, etc.	2,000
Pump house	300
Belt driven centrifugal pumping 15,000 gallons per hour	500
Belt driven air compressor or blower, capacity 60 cu. ft. per minute	1,000
Motor for driving the above pump and compressor and blower	1,000
Piping and fittings	700
Counter shafting and driving gear	300
Contingencies	200
TOTAL	6,000

Running expenses for a season of six months

	Rs.
Lime 1,000 md. at 9 as. per md.	560
Potassium permanganate, 11 cwt. at Rs. 64 per cwt.	700
Labour	500
Power from factory	200
Repairs to plant	190
TOTAL	2,150

It may be realized that the capital cost and running expenses are negligible considering the amount of effluent purified, improving the general sanitation of the factory and radically removing a standing nuisance. The sludge has manurial properties and may be used as fertilizer.

It is a promising sign that a few sugar factories have already taken the initiative and are installing effluent treatment plants.

Dr W. Owen, the American bacteriologist, has made a reference to the Srivastava and Sen system as an effective method for the continuous purification of the sugar factory waste water. The process is equally adaptable in distilleries, dairies and for the purification of city effluents.

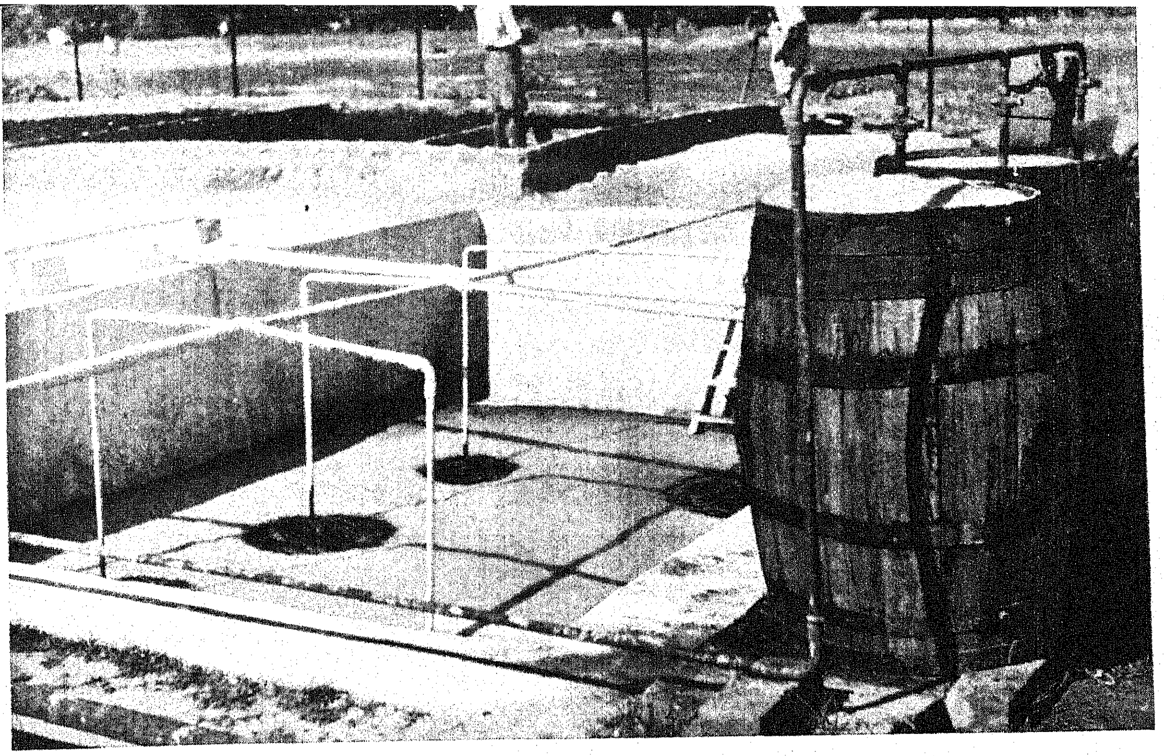
Sir John Russell, F.R.S., during his visit to the Imperial Institute of Sugar Technology, referred to the aerobic oxidation of the polluted water in percolators being adopted in earlier days in the United Kingdom. But when dealing with large volumes of polluted water for purification in comparatively short periods he was in favour of the aerobic process as the ready solution.

Cane molasses into manure

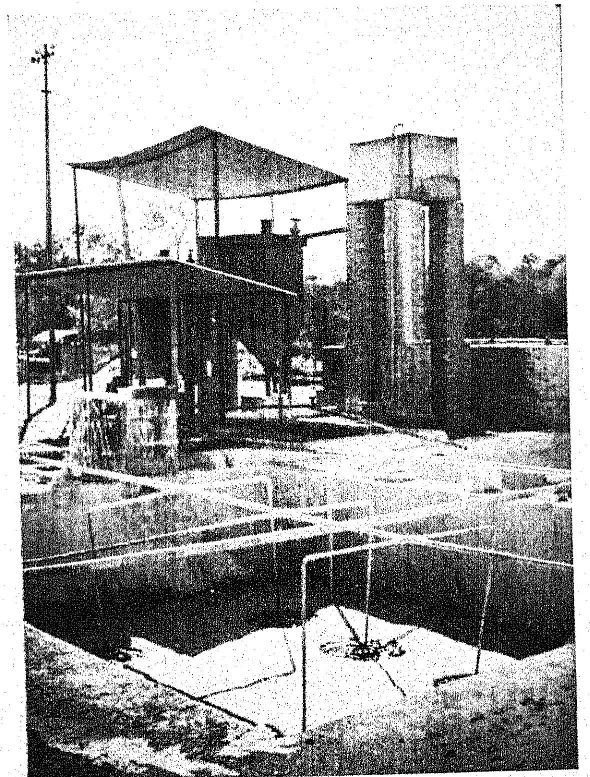
The application of molasses to the soil as manure has been a subject of research for a fairly long time both in India and abroad, and the uncertainty in the results so far obtained by different workers may be ascribed to the fact that molasses on fermentation in the soil produce acids which retard plant growth. When molasses is applied in comparatively small doses, where the alkalinity of the soil is sufficient to cope with the acids produced, deleterious effect is not so evident; but when molasses is applied in heavy doses the depressant action is quite significant.

The mechanism of reaction taking place in the soil on direct application of molasses seems to be very complicated, and this is rendered more difficult by the varied soil flora present, the reactions taking place leading to uncertain results—sometimes nitrogen fixation and in other cases nitrogen loss.

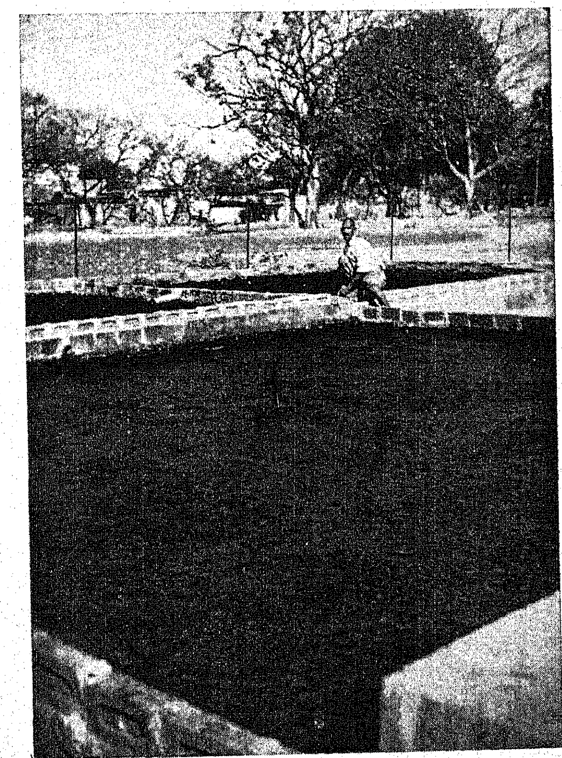
The main difficulty in the use of molasses directly in the soil lies in the fact that it is to be applied in a diluted form and a large bulk of water is necessary for the purpose. Moreover, the application of such diluted solution in the field invariably spreads an unbearable smell all along the water channel leading such polluted water and particularly in cases where there is accumulation of diluted molasses solution in pits.



Manufacture of manure from molasses
The casks contain heavily fermenting molasses wash made from pure yeast culture.



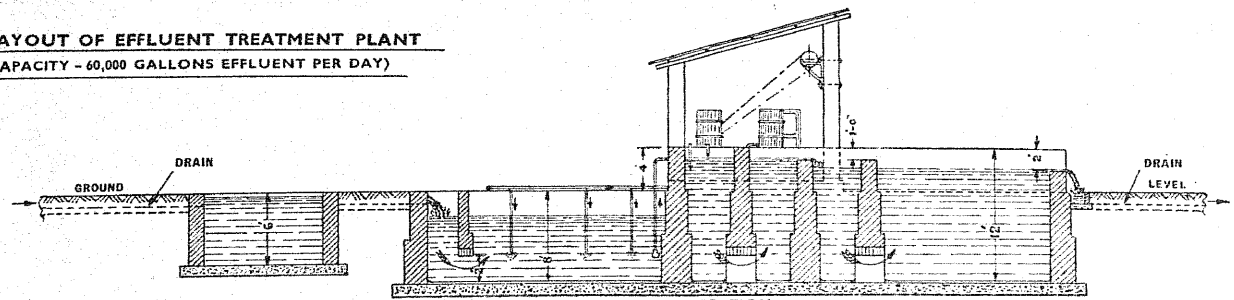
Manufacture of manure from molasses
The drums containing milk of lime
may be seen in the background.



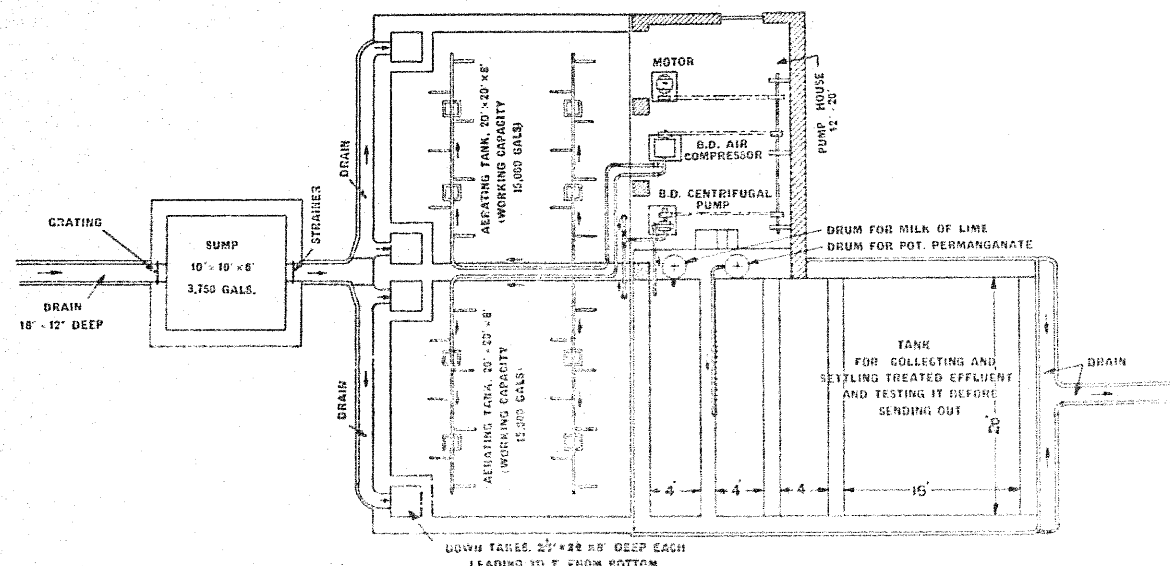
Sun-drying beds arranged in a slope, allow
separation of the supernatant liquid, leaving
the black sludge for drying.

LAYOUT OF EFFLUENT TREATMENT PLANT

(CAPACITY - 60,000 GALLONS EFFLUENT PER DAY)



— CROSS SECTION —



— PLAN —

These considerations and the problem of conversion of large quantities of molasses in a comparatively short time led to the development of a simple process. It depends on the increased production of yeast cell body by carrying on the fermentation at the neutral point under conditions of heavy aeration, the acidity produced being intermittently neutralized with milk of lime or soda.

Molasses manure

While molasses has very little value as manure, the one obtained by the method described above containing its biological products—yeast, calcium acetate, butyrate, lactate, and nitrogenous decomposition products—has high manurial value. The nitrogen content in molasses is 0·25 while that in the manure varies from 1·25—2·1 per cent. The manure obtained, moreover, is inodorous and dry and hence easily transportable to the fields, as compared with molasses which is sticky and difficult to handle. The manure contains plant hormones and gives vigorous plant growth in comparatively small doses.

Cropping tests indicate high yields

It was found that molasses, when directly applied to the soil, had depressant effect as compared with control in heavy doses and increased with increased application, although in smaller doses the effect was not very significant. The concentrated manures, on the other hand, gave definitely increased crop yields comparable with yields obtained using castor-cake as manure. The sucrose per cent in cane was slightly higher with concentrated manures than with molasses.

Plant for manufacture

The masonry tanks, air compressors, pumps and aerating pipe lines of the effluent plant may conveniently be used for the manufacture of molasses manure during the off-season. An additional expenditure will be incurred in making sun-drying beds. Twelve shallow beds may be constructed of a convenient size—40 ft.$\times$40 ft.$\times$2 ft.—arranged in a slope to allow the supernatant liquid to flow from one bed to another, leaving the black sludge. The latter is turned over with rakes till it is completely dried, when it is ground to powder and bagged for transport. The bed is consolidated by putting one inch ballast and covered up with a thin layer ($\frac{1}{8}$ in.) of ash and lime mortar. The approximate cost of constructing these shallow masonry beds may be taken as Rs. 1,000.

Comparative yields of sugarcane and sugar per acre and quantities of different manures and molasses applied

Co 312. Kalyanpur Farm, 1938-39

Treatments	Cane yield per acre	Yield of sugar per acre	Excess over control		Excess over F.		Quantities of manure or molasses per acre
			Cane	Sugar	Cane	Sugar	
	Md.	Md.	Md.	Md.	Md.	Md.	Md.
A. Manure from molasses with lime addition at 60 lb. N per acre	1,048·5	128·15	+104·78	+17·7	+355·5	+42·8	75
B. Do. at 120 lb. N per acre .	1,073·28	118·96	+139·50	+6·7	+380·2	+33·60	150
C. Manure from molasses and filter press cake at 60 lb. N per acre	1,041·25	127·70	+107·50	+16·3	+348·2	+42·4	75
D. Do. at 120 lb. N per acre .	983·25	120·05	+49·5	+8·6	+290·0	+34·75	150
E. Molasses, direct application at 60 lb. N per acre	731·0	111·52	—200·0	—0·09	+38·0	+26·22	300
F. Do. at 120 lb. N per acre .	693·0	85·3	—240·7	—26·1	..	..	600
G. Castor-cake at 60 lb. N per acre	1,012·5	117·65	+78·75	+6·2	+310·5	+32·35	19
H. Do. at 120 lb. N per acre .	951·75	100·50	+18·0	+10·9	+258·75	+15·2	38
I. Control	933·75	111·43	..	..	+240·75	+26·31	..

Cost of molasses manure

Molasses 240 md. with an equal quantity of filter press cake (50 per cent moisture) yield about 40 per cent manure on the total solids—approximately 172 md.

	Rs.
Cost of exhaust molasses, 240 md., 4 as. per md.	60-0
Filter press cake at 6 pies per md.	7-8
Nicifos at Rs. 6 per md., 4½ md., containing 17 per cent N and 17 per cent P	27-0
Lime 40 md. at 8 as. per md.	20-0
Electricity at 1 anna per unit KWH	1-8
Labour, 2 coolies for six days at 5 as. per day	3-12
TOTAL (for manufacturing 172 md. manure)	119-12
	or approximately Rs. 120

Hence cost per maund of manure 0-11-3 or 12 as.

The cost of manure works out to 12 as. per maund, giving a return of 4 as. on molasses and 6 pies on filter press cake per maund.

Profit from manure

Apart from avoiding a permanent nuisance and improving the sanitary conditions of the factory, the manufacture of manure will be a source of income to the sugar factories. It may be estimated that if only one-fourth of the total output of molasses and filter press cake are treated every day, e.g. for a 1,400 ton factory 13 tons of molasses and an equal quantity of filter press cake, there will be a yield of 9·5 tons of manure per day. If the manure is sold at Re. 1 per maund, the daily income from the sale of manure will come to Rs. 225.

As a result of the war the prices of inorganic manures—ammonium sulphate, superphosphate, ammonium phosphate, etc.—have gone up considerably and at times they are not available. Indian soils are generally deficient in organic matter and therefore requires organic manure to improve their fertility. Therefore the manufacture of concentrated manures from molasses having potent growth-promoting accessories should prove a boon to sugarcane growers.

SIMPLE SILOS

Simple quickly-made silo towers are becoming popular in Britain. To meet the need for construction material for such towers lining material with a strong hessian backing has been invented and sold by certain firms. This lining is spread inside cylindrical frames made of sapling poles, sheep hurdles, or old fencing, bound together with wire.

BIGGER LEGUME YIELDS FROM INOCULATED SEEDS

By M. R. Madhok, Ph.D., Assoc. I.A.R.I.
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ALL pod-forming crops like grams, peas, *guara*, *jantar*, *arhar*, berseem, etc. belong to a group of plants called the 'legumes' or leguminous crops. They differ from other crops, viz. the non-legumes, by the presence on their roots of bead-like growths called nodules (Fig. 1). In these nodules reside millions of invisible bacteria which live in symbiosis (or a relation of give and take) with the plant; they use the cell sap of the plant for their nutritional requirements and in return fix nitrogen of the atmosphere and give it to the plant.

It is due to the untiring labour of these invisible lodgers in the nodules on the roots of legumes that these crops get a larger portion of their nitrogen supply from the atmosphere and thus differ characteristically from the non-legumes (e.g. cereals) which are entirely dependent on the soil for their nitrogen requirements. It is because of their property of gathering nitrogen from the atmosphere that legumes find a prominent place in all the well-balanced systems of crop rotations. Legumes are also preferred for green manuring purposes because of their high protein content.

Nodule bacteria are commonly present in the soil but unless they form nodules on the roots of a legume they are unable to fix nitrogen from the atmosphere, and conversely unless the legume roots give abode to these useful bacteria and develop nodules they are unable to utilize atmospheric nitrogen. The presence of the nodule-forming bacteria in the soil is therefore very essential for getting a successful crop of any legume.

Formation of nodules

As the legume roots grow in the soil they come in contact with the specific nodule bacteria which invade the tender rootlets and form tubercle-like growths called nodules. It is these nodules which serve as a seat of nitrogen fixation by these bacteria. According to a recent theory, the growing rootlets of a legume give out some excretions to attract the desirable type of nodule bacteria while the bacteria after their invasion of the rootlet cause a bending of the root tissue with the help of certain excretions. It is at this bend where the root tissue is weakened that a nodule is formed.

Groups of nodule bacteria

There are several different groups of nodule bacteria and each group is capable of forming nodules only within a definite group of legume plants. Therefore only a specific type of nodule bacteria can form nodules on the roots of any particular legume, e.g. the organism-forming nodules on the roots of berseem (Egyptian clover) would not form nodules on the roots of lucerne and *vice versa* while it would form nodules on the roots of *shaftal* (Persian clover). There are about eight such main cross inoculating groups of these bacteria.

Efficient and inefficient strains

It has recently been found that the bacteria-forming nodules on the roots of legumes differ greatly in their capacity to fix atmospheric nitrogen. The number of nodules formed on the roots of a particular plant may be quite large and yet if these are inhabited by an inefficient strain of bacteria there may not be any appreciable fixation of nitrogen. It is therefore essential that only carefully selected efficient strains are used for inoculation purposes.

Natural sources

As mentioned already, the natural habitat of nodule bacteria is the soil. When a legume is planted in any soil, the particular group of

bacteria capable of forming nodules on its roots soon invade the newly formed rootlets. This is true for most of the commonly grown legumes provided the soil conditions (reaction, moisture, etc.) are favourable for the existence and growth of these organisms. But in cases where a legume is planted for the first time in any soil or where a number of years have elapsed when this legume or any member of its cross-inoculating group was sown in this particular field, it is very likely that nodule formation would be sparse and the vegetative growth poor. This condition can generally be remedied by artificial inoculation of the seed or soil with the requisite type of bacteria. In cases where the soil conditions also are unfavourable for the growth of these organisms, liming of the soil or the application of phosphates is generally helpful.

Methods of inoculation

The more or less continuous growth of leguminous crops helps to maintain the legume bacteria population in the soil. In cases, however, where the requisite group of nodule bacteria is absent in the soil, as for instance where a new legume is being introduced or where a particular legume is being sown after a lapse of many years, the soil or the seed can be inoculated by one of the following methods:

(1) *The soil method.*—A few cartloads of soil are transferred from a field where a particular crop is known to do well and the carted soil evenly mixed with the top layer in the new field before sowing.

This method is rather cumbersome and disadvantageous because it not only necessitates the carting of a huge quantity of soil but has a distinct drawback in transferring, besides the requisite type of nodule bacteria, other disease germs from one field to another.

(2) *Pure culture method.*—This method consists in isolating a particular strain of the desired nodule bacteria from healthy nodules of the same plant. The procedure requires specialized training and consists mainly in sterilizing the surface of the nodule, crushing it under aseptic conditions and cultivating the bacteria from the inside on a suitable nutrient food material.

The bacteria so isolated can be cultivated under artificial conditions in the laboratory and used for purposes of inoculating the seed when necessary. In Europe and the United States such pure cultures of nodule bacteria are manufactured by various commercial firms and put on the market under various patent names with varying claims. These cultures are sold either in a liquid form or on a jelly-like medium or mixed with sterilized muck or soil.

In India the preparation and sale of nodule bacteria cultures was at first started in 1928 in the bacteriological laboratory of the Punjab Agricultural College, Lyallpur.

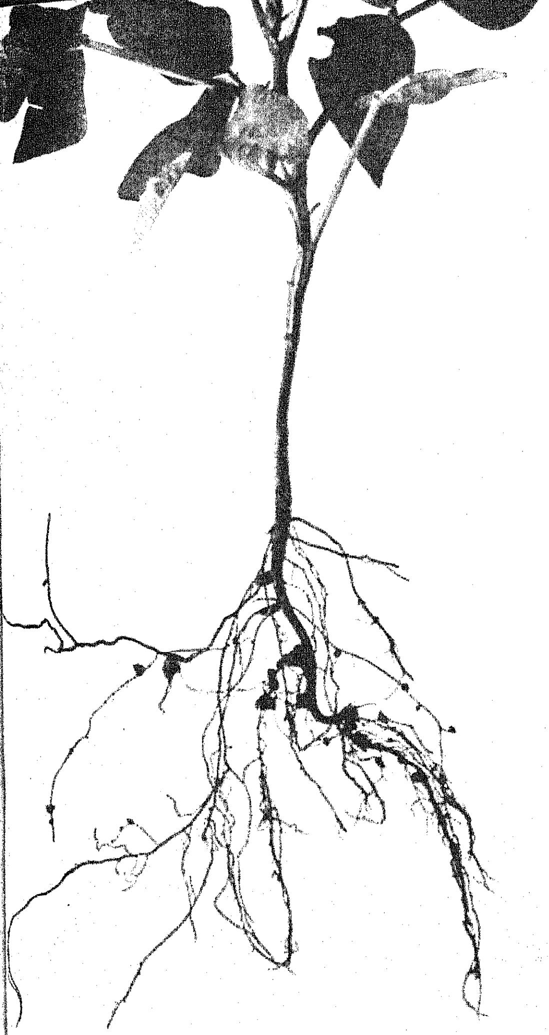
Experiments in the Punjab

Towards the end of 1927, reports were received that berseem, then a newly introduced fodder crop, was not doing well at several places in the Punjab; at most places the plants remained stunted in growth and the foliage was reddish brown in colour. On investigation the trouble was found to be due to the absence of nodules on the roots of plants. This showed that the specific nodule organism was absent in the soils examined.

In February 1928 a trial inoculation experiment was conducted at the Lyallpur farm. Berseem was sown on a piece of land that had never grown this particular crop previously. Some plots were sown with the inoculated and others with the uninoculated seed. The plants from the inoculated seed were found to be much taller, greener and with plenty of nodules on the roots while the uninoculated plants were stunted in growth, with reddish brown foliage (Fig. 2).

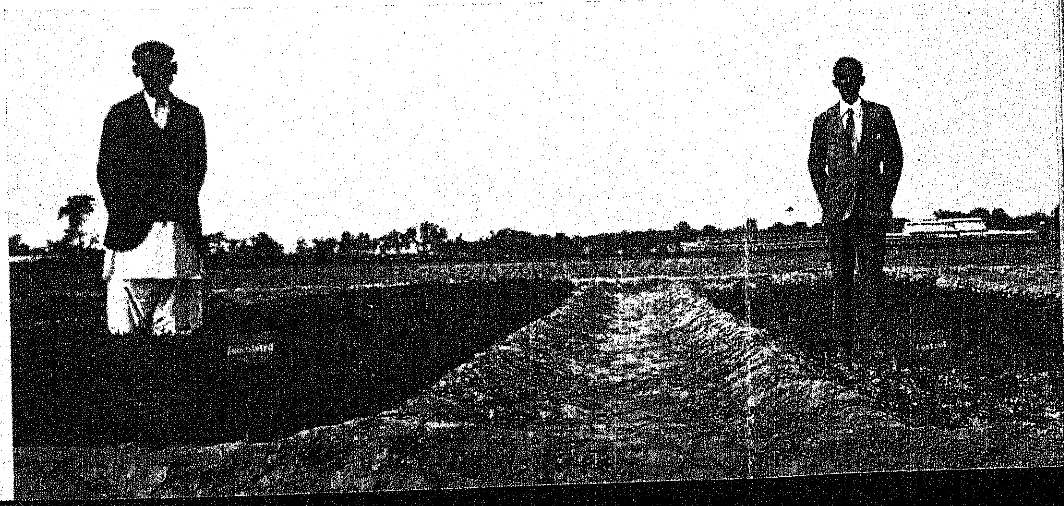
The yield (one cut only) of green fodder from the inoculated plots was found to be 18·3 md. per acre while the yield from uninoculated plots was only 3·7 md. per acre. The difference in the appearance of crop growth and in the yield of green fodder as observed in 1929 trials is depicted in Figs. 3 & 4.

After the first encouraging results, inoculation experiments on berseem were conducted at several places in the Punjab and everywhere



. 1. Nodules on the roots of a legume plant

FIG. 2. Comparative size of uninoculated and inoculated plan



. 3. Stand of crop
n inoculated and
uninoculated plots

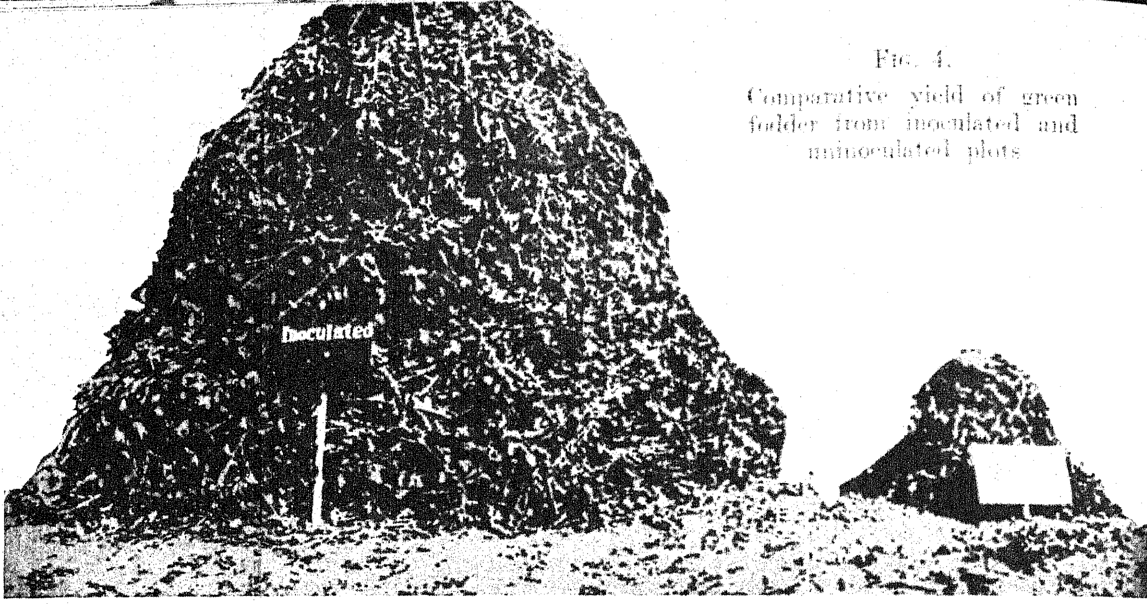
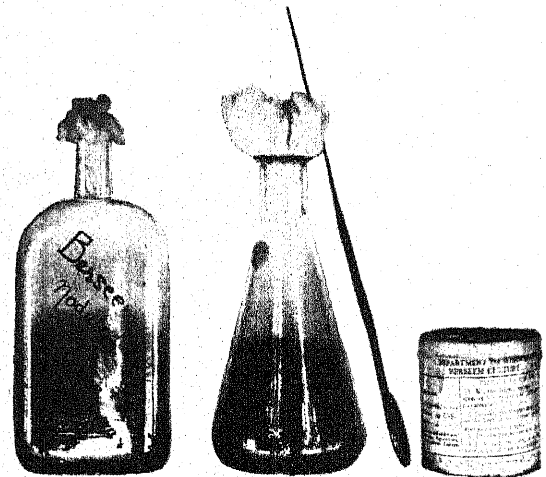


FIG. 4.
Comparative yield of green fodder from inoculated and uninoculated plots



A B C

FIG. 5. Different steps in the preparation of a nodule organism culture : *A*. Mass pure culture on a bottle slant. *B*. Soil culture flask and spatula. *C*. A culture tin

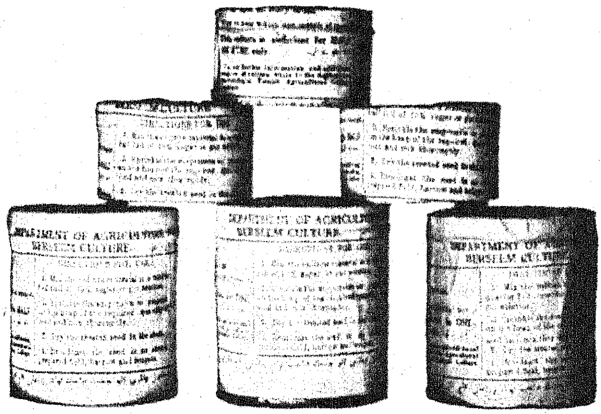


FIG. 7.
Culture tins of different sizes ready for despatch

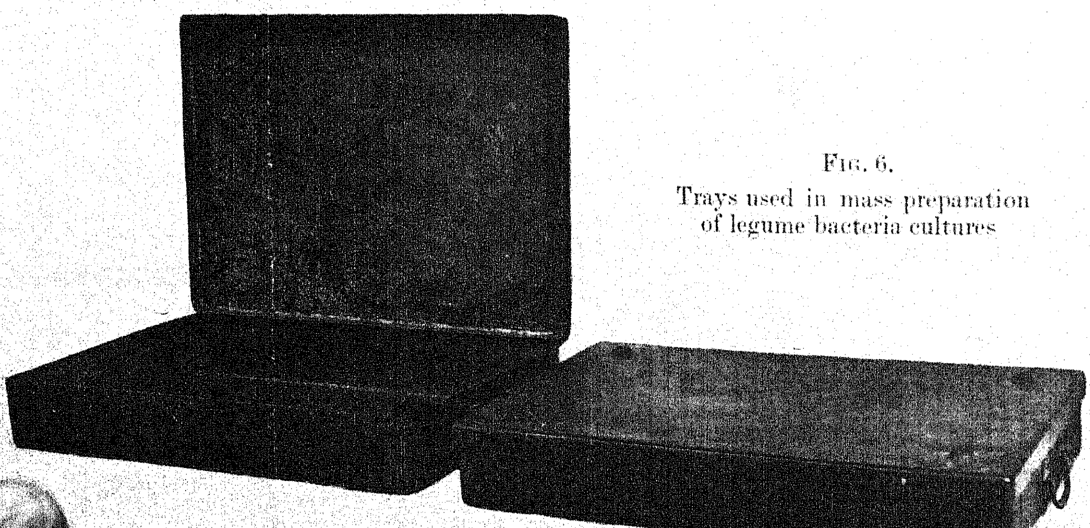


FIG. 6.
Trays used in mass preparation of legume bacteria cultures

the inoculated crop was found to give a far higher yield of green fodder than the uninoculated crop. The average increase of green fodder per acre for the whole province was found to be over 169 maunds and this valued at 6 as. per maund (the price then prevailing) gave a net profit of over Rs. 63 per acre as a result of inoculation.*

Inoculation of berseem having proved beneficial, it was considered desirable to supply the inoculation material to the farmers of the province. At first a few cultures were supplied to some prominent zemindars on a jelly (agar agar) medium (Fig. 5-A) but it was soon realized that these agar agar cultures were not suitable for our conditions. Our illiterate farmer could not realize the importance of the extreme care required in handling and storing these cultures; the glass bottles used for these cultures could not be transported over long distances to remote villages without the risk of breakage and the cultures if stored carelessly would soon dry up with a consequent death of the culture organism. To overcome this difficulty a soil leafmold medium was later employed for the preparation of these cultures. Cultures in such a soil leafmold medium were found to contain a far greater number of nodule bacteria than the agar cultures and besides being more convenient to handle were found to be less liable to deterioration under unfavourable conditions and quite efficacious for inoculation purposes.

Preparation of legume cultures

These soil leafmold cultures were originally prepared singly in pyrex glass flasks (Fig. 5-B) but with the increase in the sale of these cultures from a couple of hundreds in 1930 to over 1,300 in 1933, it became difficult to cope with the increased demand without a distinct modification of the procedure for the preparation of these cultures. As a result of extensive trials a method has been evolved by which the cultures can be prepared in bulk without impairing the nodule-forming capacity of the organism. The method consists in sterilizing the selected soil leafmold medium containing sugar in specially prepared trays, its inoculation in bulk with a mass pure culture of the desired organism and later distribution of the prepared culture in small tins. A brief résumé of the various steps involved in the process is given here.

The method : medium

The first essential in the work of the preparation of legume cultures is the selection of a proper soil medium. As described in the author's previous article in *Agriculture and Livestock in India*, garden soil which is generally a mixture of soil and leafmold is quite a good medium and better than soil alone or sludge.

Since the composition of leafmold is variable, it is best to find out by a preliminary trial the proportions of a particular leafmold and soil that would give optimum growth of the required culture. The soil selected should preferably be a good sandy loam of neutral or slightly alkaline reaction.

Trays

The trays employed in this work are usually those made of copper which is thoroughly tinned on the inside. The size of the trays can be arranged according to the dimensions of the autoclave but the depth of the soil medium in a tray should in no case be more than three inches. Only horizontal autoclaves can be used for this type of work.

In our laboratory we use trays measuring 20 in. × 14 in. with a height of 3 in. Three such trays can be accommodated at a time in our autoclave which measures 28 in. in length and has a diameter of 18 in.

The lid of the tray should be well fitting with four bulges at the top (Fig. 6). Iron trays cannot be used for this type of work as they soon rust up with frequent steam sterilizations.

Culture bottles

Since inoculation of trays requires the use of a mass pure culture, culture bottles made of resistant glass and measuring 8 in. × 4 in.

*1. Details of these experiments were published in *The Indian Journal of Agricultural Science*, **3** (1933) pp. 16-32.

2. For details regarding the use of these cultures in a soil leafmold medium reference may be made to the author's previous article on the subject published in *Agriculture and Livestock in India*, **4** (1934) pp. 670-82.

and 2 in. thickness have been found to be convenient for preparing slant cultures. The medium used for the purpose is either the soil extract mannite agar or the yeast extract mannite agar of the following composition :

Soil extract mannite agar		Yeast extract mannite agar	
Mannite . . .	20 gm.	Mannite . .	20 gm.
K_2HPO_4 . .	1 gm.	K_2HPO_4 . .	1 gm.
Soil extract (800 gm. of good soil steamed with 1,200 cc. tap water)	1,000 cc.	Yeast extract (10 gm. dried yeast boiled in 100 cc. water and filtered).	100 cc.
		Water . . .	900 cc.
Agar agar . .	20 gm.	Agar agar . .	20 gm.
Reaction . .	pH 7·4	Reaction . .	pH 7·4

Where economy is the chief consideration ordinary cane sugar can be used in place of mannite.

Procedure

The amount* of soil that would fill the tray to a depth of about 3 inches is heaped on a clean tight floor or tarpaulin. Sugar to supply 1 per cent on the basis of soil is weighed and added to a measured quantity of water that has been found by trial to be sufficient to bring the above quantity of soil to optimum moisture content. The syrup so prepared is then poured on the heaped soil and the latter thoroughly mixed by hand.

The moist medium is then transferred to a tray which is sterilized at 20 lb. pressure. In practice sterilization has been done for three hours but this year's† trials have shown that a lesser time (i.e. half to one hour) is good enough. A number of such trays can be sterilized together depending on the size of the autoclave. The four bulges on the top lid are meant for resting trays, one on the top of another, without hindering the free flow of steam. After sterilization the tray is allowed to cool down to room temperature with the lid kept on. This usually takes three to five hours according to the room temperature. For inoculation purposes the growth of one bottle slant is transferred with sterilized water to a conical flask containing about 500 cc. of sterilized water. The flask is then thoroughly shaken till the contents are homogeneous-milky hue. This suspension of the nodule organism is then distributed evenly on the surface of the soil and thoroughly mixed with washed and cleaned hands. The culture so prepared is then incubated for three or four days before it is ready for use.

For packing purposes we have found it very convenient and cheap to use empty cigarette tins (Fig. 7). These tins are cleaned, washed, lined with clean paper and sterilized before use. About 200 gm. of the above culture material is usually enough to inoculate seed for an acre of land.

The above detailed method initially evolved in 1934 has since been used quite successfully for the preparation and supply of cultures in our laboratory. A further detailed study of the extent and influence of contaminating organisms in such bulk cultures on the infective power of the specific organism was undertaken last year. As a result of this study the method has been found to be quite authentic from a technical point of view.

Method of seed inoculation

The main idea of inoculation for the legumes is to introduce the specific nodule bacteria in soil so that proper nodulation of the roots takes place. As detailed above this could either be accomplished by transferring a few cartloads of soil from the field where the particular crop is known to do well or by means of artificial inoculation with pure culture.

In the latter case instead of broadcasting the culture in the field it has been found much more convenient to inoculate the seed before sowing. This is generally done as follows for most *rabi* fodder crops :

1. For inoculating seed sufficient for one acre, prepare about half a seer of sugar solution (one part of raw or refined sugar in nine parts of water).
2. Mix one soil culture with it so as to form a muddy suspension.
3. Heap the seed on a gunny bag, tarpaulin or on a clean tight floor.
4. Sprinkle the muddy suspension on the heap and mix it thoroughly, so that each seed is moistened.

* Nearly 12 seers of the soil medium are enough to fill our tray measuring 20 in. × 14 in. with a depth of 3 inches.

† 1939.

5. Spread the inoculated seed in a thin layer in shade, handling over at intervals until it is dry enough to sow.

6. Broadcast the inoculated seed in the evening on an already prepared land, ploughed and levelled.

7. *Harrow it lightly to give the inoculated seed a thin covering of soil as protection against the sun.

8. Water the field immediately after it has been sown.

The procedure for inoculating the seed is the same for all other legume crops though the method of sowing differs in different cases.

Cultures by private manufacturers

As the demand for these cultures has considerably increased in recent years some people with little knowledge of bacteriology have started the preparation and sale of such cultures. The product of two private manufacturers was recently examined and was found to be of very poor quality. In one case it was suspected that only moist soil was being sold out as cultures. At the moment of writing this note we do not know of any reliable private manufacturer of legume cultures in India.

Tests for quality

The only reliable evidence of the genuineness of these cultures is the formation of nodules on the roots of a legume for which the culture is specific, but the procedure takes time and requires such rigid precautions that few cultivators can run it at home. There are other simple tests but these can be run only by a trained bacteriologist in a well-fitted laboratory. The best safeguard, therefore, is to buy your legume cultures from a Government laboratory or from manufacturers whose products bear the seal of approval of a recognized Government bacteriologist.

Repeated inoculations

Generally speaking, if a particular plot of land is once sown with an inoculated seed of a particular legume further inoculations are not necessary but an increase of 10 to 20 per cent in crop yields has been recorded by some as a result of reinoculation.

In cases where a particular legume has not been sown on a particular field for a long time it is always advisable to inoculate the seed before sowing.

* Ordinary *phallah* used for thrashing wheat or a similar device may advantageously be used instead of the bar harrow.

DRYING OF VEGETABLES

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DUE to the possible use of dried vegetables as army rations, a large number of enquiries as to the method of drying vegetables, particularly potatoes, have been received at the Punjab Agricultural College from all over India. It is extremely difficult to reply individually to such enquiries in detail. An effort has, therefore, been made to give in this article (1) the general principles involved in the drying of vegetables, (2) a detailed method of drying potatoes and also brief outlines of the methods of drying some of the important vegetables like onions, cauliflower, carrots and peas with some experimental results obtained in this connection under the Fruit and Vegetable Preservation scheme, Lyallpur, financed jointly by the Punjab Government and the Imperial Council of Agricultural Research.

Sun-drying v. *dehydration*

There are two methods used for drying fruits and vegetables, viz. drying in the sun and dehydration, i.e. the removal of moisture by artificial heat in specially constructed chambers called dehydraters where temperature, humidity, and rate of flow of the air in the drying chamber can be regulated. While sun-drying is largely practised for drying fruits and the product also is of satisfactory quality, though not coming to the standard of the dehydrated product, vegetables are seldom dried in the sun as they generally acquire unattractive colour and are poor in taste and cooking quality. Dehydration has also other advantages over sun-drying inasmuch as (*a*) the product is kept free from dust, (*b*) flies get no chance of depositing eggs on the product, (*c*) drying time is greatly reduced, (*d*) danger of damage by rain, storm or humid atmosphere is eliminated, and (*e*) a product of more uniform quality can be got. A dehydrated product is generally of better quality although the cost of dehydration must necessarily be more than that of sun-drying. Hence dehydration is generally employed for drying vegetables and the product thus obtained, in most cases, is a very satisfactory substitute for fresh vegetables after the dehydrated vegetables have been soaked for several hours before use.

Sun-drying

Sun-drying, mostly used for drying fruits, does not require any complicated equipment. The prepared fruit is spread on specially constructed wooden trays, the size depending on the type of fruit used, and the trays are placed singly in long rows on wooden framework (about 1 ft. above ground-level) directly in the sun in an open yard called the drying yard. The size of the trays may be 3 ft. × 8 ft. or 2 ft. × 3 ft. or 3 ft. × 6 ft., and they are generally made of wooden slats or strips if used for drying fruits, and of screen mesh ($\frac{1}{8}$ inch) for vegetables. Flies, bees and wasps become a serious nuisance in sun-drying and are extremely difficult to control. Fine mosquito netting or fine metallic screens may be used with advantage for covering the exposed trays.

Dehydration on home scale

Vegetables in the home are dehydrated in a 'home-drier'. The type of home drier at Lyallpur used for collecting the experimental data, given later in this article, is shown in

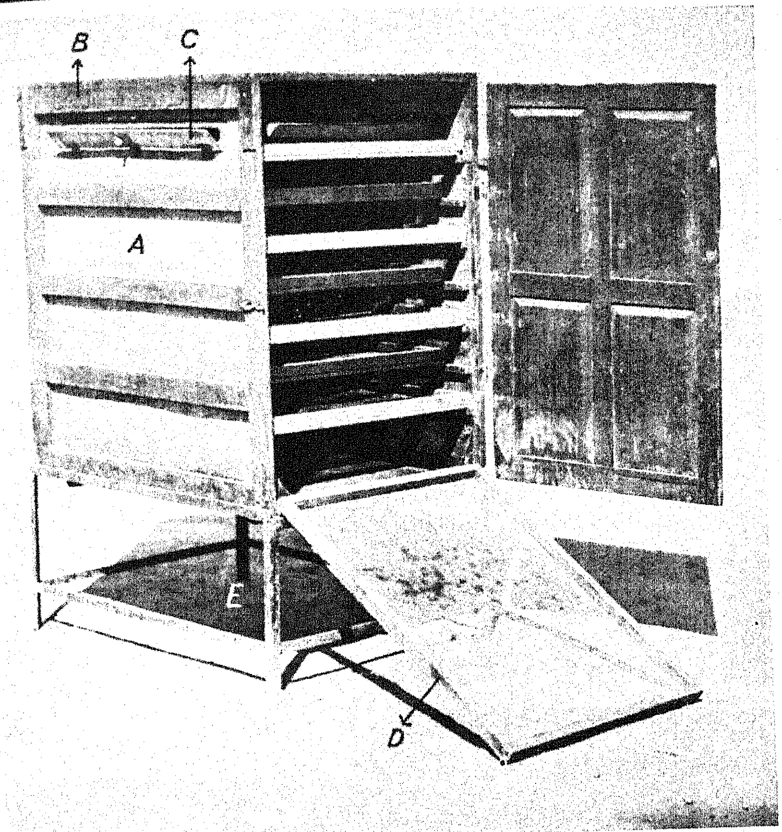

FIG. 1. Home-drier for dehydrating fruits and vegetables

A. Galvanized iron chamber 3 ft. × 2 ft. × 3 ft.

B. Wooden frame enclosing chamber A

C. Collapsible metallic flap to regulate the flow of evaporating moist air

D. $\frac{1}{8}$in. mesh galvanized iron screen tray (32in. × 24in.)

E. Space for placing the source of heat

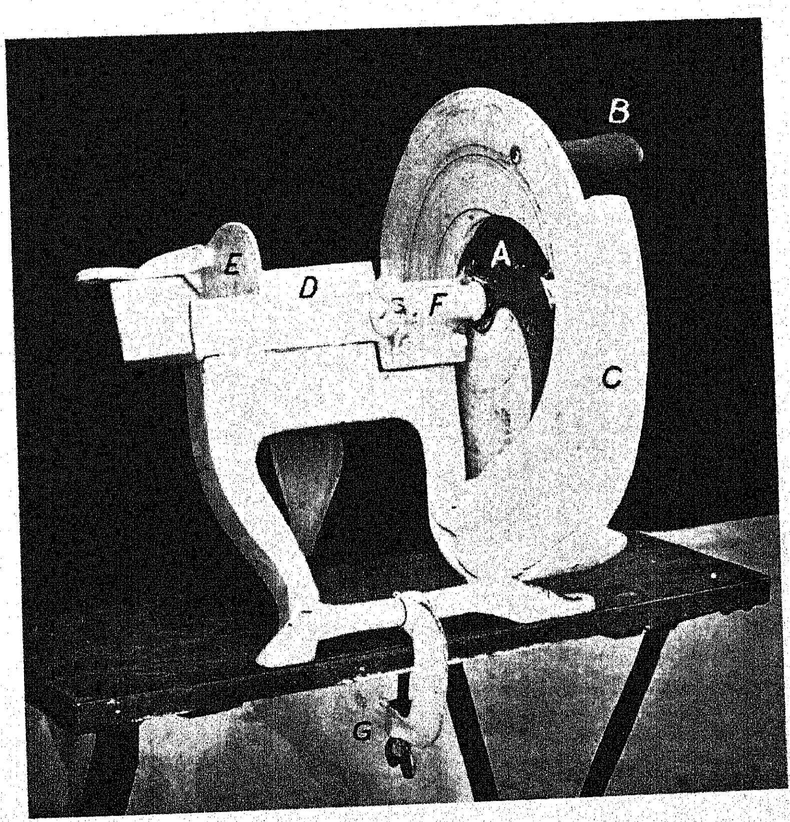

FIG. 3. Sterling slicer No. 20 (U. S. A. make)

A. Sharp, curved steel knife

B. Handle to revolve knife

C. Guard against the revolving knife

D. Space for putting potatoes

E. A movable device to push the potatoes for slicing

F. Screws to adjust the postion of steel blade to cut slices of a desired thickness

G. Screws to fix the slicer on the working table

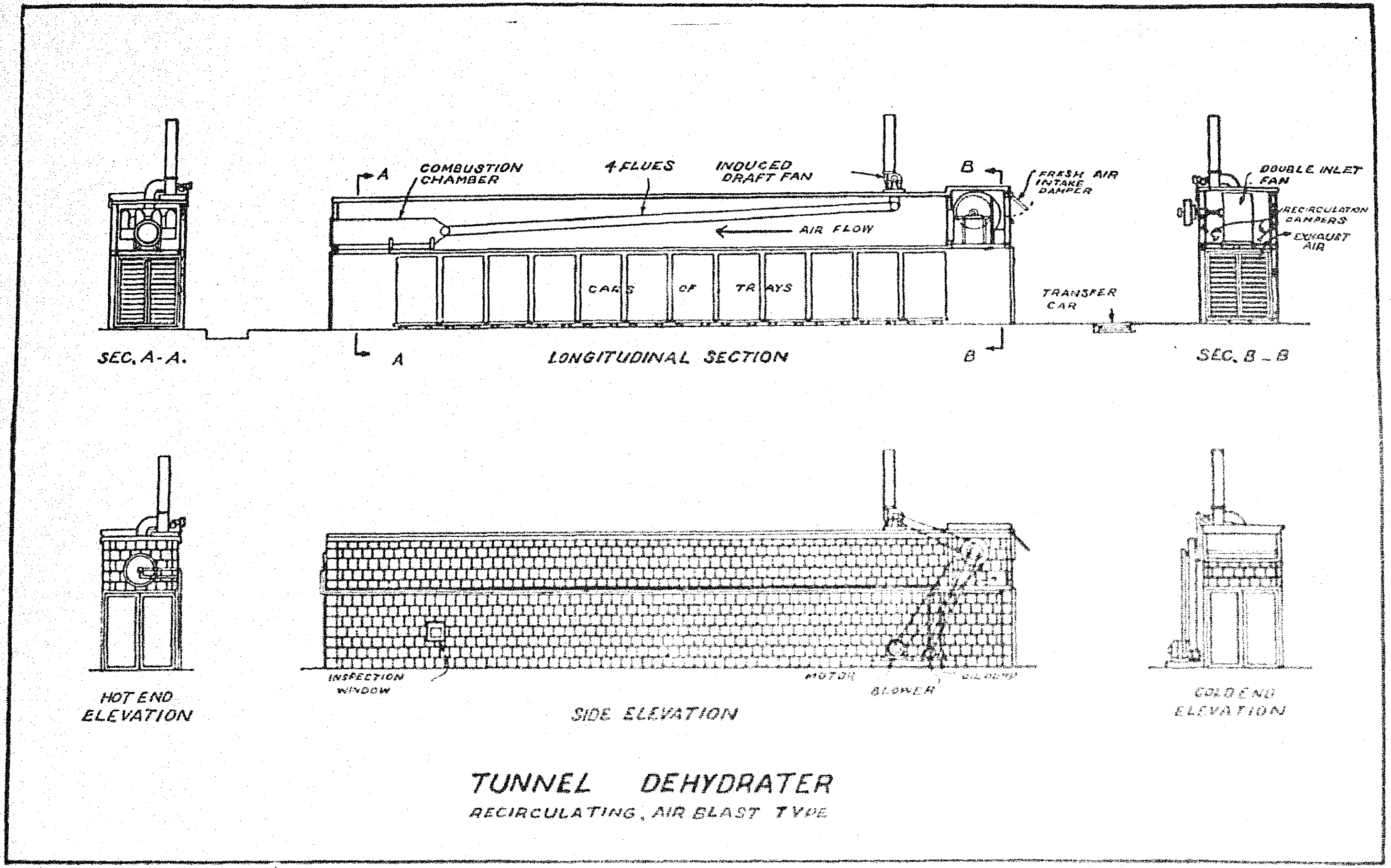

FIG. 2. Recirculation air-blast tunnel dehydrater (after Christie & Ridley)

Fig. 1. This is a strong galvanized iron sheet box 3 ft. × 2 ft. × 3 ft., with a strong perforated iron sheet bottom. The sides and top of this box are enclosed in wooden framework and the box is supported on an iron stand $1\frac{1}{4}$ ft. high. The source of heat can be an ordinary petroleum oil-stove, or a small charcoal furnace (*angithi*) placed below the perforated bottom (in the experiments reported later, due to the availability of gas, large gas burners were used for heating). In order to let off the moisture the drier has slits 2 ft. × 1·5 in. along the length on both sides about 4 in. below the top. These slits have collapsible metallic flaps which can be opened or closed to regulate the flow of evaporating moist air. The drier can accommodate 7 trays $2\frac{3}{4}$ ft. × 2 ft.

Dehydration on commercial scale

For commercial dehydration several types of dehydraters like the kiln type, stack driers, recirculating air blast type drier, Oregon tunnel driers, etc. are used in foreign countries. For details, reference may be made to the bibliography at the end of this article. No such commercial dehydraters are known to exist in this country at present.

For the prospective manufacturers of dried fruits and vegetables, particularly the latter, the following courses are open :

(*a*) The purchase of a standard commercially built dehydrater.

(*b*) Construction of a dehydrater from plans furnished by a dehydrater manufacturer or engineer.

(*c*) Construction of a dehydrater from an original design.

Names and addresses of some of the dehydrater manufacturers in the United States of America are given at the end of this article.

Unfortunately, there are no firms in India which can supply commercially built dehydraters or furnish a working plan. Due to the present unsettled conditions, the difficulties of importing them are indeed great. An attempt has, therefore, been made to reproduce an original design of a tunnel dehydrater (recirculating air blast type after Christie and Ridley 1929) in Fig. 2. This type of dehydrater is widely used in the United States of America and is stated by Cruess* to be superior to the kiln, stack or Oregon type tunnel driers. It is hoped that persons with construction experience and a knowledge of heat and ventilation engineering will be able to construct a dehydrater in accordance with the plans outlined in Fig. 2.

Some important points for constructing this dehydrater are given below :

1. Fire-proof material like hollow tiles, concrete, double-sheet metal or other fire-proof material like asbestos, is used for constructing the chamber as shown in the side elevation.

2. The material to be dried in the case of vegetables is spread uniformly on $\frac{1}{8}$ inch mesh screen trays $2\frac{1}{2}$ ft. × $2\frac{1}{2}$ ft. or 3 ft. × 3 ft. There should be about 2 in. space between each tray when they are placed one over another for free circulation of air. It is preferable to use monel (a special non-corrodible alloy of nickel, copper and manganese) metal screen trays for acid vegetables like tomatoes and rhubarb, but for non-acid vegatables like potatoes, onions, cauliflower, ordinary galvanized iron wire-gauze screens can serve the purpose. These trays are placed one over the other in trolleys or cars which are pushed in the tunnel on special tracks but are usually equipped with castor wheels to permit moving on the floor of the preparation shed which, of course, is separately built. The size of such a shed will depend upon the output desired.

3. The width and height of the drying tunnel should be just enough to accommodate the trolleys or cars with two stacks of about 20-25 trays ($2\frac{1}{2}$ ft. × $2\frac{1}{2}$ ft. or 3 ft. × 3 ft.) on each.

4. The length of the tunnel is usually 30 to 40 ft. and accommodates about a dozen loaded cars or trolleys. The length of the tunnel can, of course, be decreased for smaller output.

5. Fuel oil is generally used for heating the combustion chamber which can also be heated by means of steam pipes, but it is believed that the combustion furnace can be designed to burn wood, charcoal or coke.

6. As seen in the plan (Fig. 2 longitudinal section) there are two chambers—the drying

* *Fruit Products Journal*, Dec. 1940.

tunnel and the heat-producing chamber built on top of the tunnel. The heat produced in the combustion chamber, while passing through four flues (only one flue is shown in the longitudinal section of the plan), warms the air of the chamber and is circulated and recirculated in the drying tunnel by means of a blower fan (double inlet fan shown in Sec. B-B), placed on one side of the dehydrater on top of the drying tunnel, through an opening on the other side (near the exit end of the trolleys) between the drying chamber and the heating chamber. The doors of the tunnel are air-tight and the various devices to control the flow of the hot air are explained in the plan.

Air flow and humidity

Air flow in the drying chamber between the trays should be about 500 or even 600-700 lineal feet per minute. Humidity of air in the drying chamber is a factor of considerable importance because if humidity is high, the product will cook rather than dry, thereby prolonging the drying period. But if humidity is too low, especially in the beginning of the drying process, the surface of the product will dry too quickly and cause what is commonly known as 'case-hardening' which will considerably prevent the evaporation of moisture from the inner portion of the product. Relative humidities at drying temperatures for various fruits have been worked out in foreign countries. For instance, at the end of the drying period in a tunnel dehydrater, a temperature of 165°F. and humidity of 5 to 10 per cent for apples, 160°F. and 10 per cent humidity for apricots, 160°F. and 5 per cent humidity for grapes, 150°F. and 10 to 20 per cent humidity for pears and peaches are considered desirable. Moisture content in the fruits dried in the above manner varies from 18 to 25 per cent. There is, however, no such information available in the case of dried vegetables. In the case of vegetables, the humidity factor may not be of so great an importance at the end of the drying process as at the beginning, since the vegetables have to be dried to almost the 'bone-dry' stage and the percentage of moisture in dried vegetables is only about 8 or even less. At the beginning of the drying process, however, humidity is essential to prevent 'case-hardening' and this can be adjusted by experience. Relative humidity of the air in the chamber is determined from readings of two thermometers (wet and dry bulb) placed in the drying chamber. Relative humidity figures from any combination of wet and dry bulb temperatures are given in charts in the literature on the subject.

Drying of potatoes

The method of drying potatoes has already been worked out in foreign countries and briefly described in the textbooks on the subject, but there are several aspects of the process which require a detailed study especially with reference to the type of raw material available in the Indian market, wastage due to peeling, the method and time of blanching prior to drying, yield of the dried product from freshly prepared or unprepared potatoes, etc. Prior to discussing these aspects of the problem it is desirable to give a detailed procedure for the dehydration of potatoes.

Stage I : Selection of raw material.—Potatoes having white creamy flesh have been found by the authors to be the best for drying as they yield white slices. Potatoes even with a slightly yellow-coloured flesh yield slices of yellow colour, which no doubt are a wholesome food, but are rather unattractive in appearance. Great vigilance should, therefore, be exercised in selecting the material prior to drying. For commercial drying, large-sized potato tubers are used as the dried slices are then of fairly large size and the proportion of small and broken pieces in the finished product is small (Table II). For home production even average-sized tubers would do. Prices being equal for 'new' and 'old' potatoes, it is advantageous to use the 'old' crop as this gives better yields of the dried product than the 'new' crop.

Stage II : Washing.—Potato tubers are thoroughly washed in running water or with a strong jet of water from a tap to remove dirt and other extraneous matter.

Stage III : Peeling and trimming.—Washed potatoes are peeled for large-scale production by a mechanical peeler, but in the experimental lots dried in this laboratory, peeling and trimming was done by hand with a sharp

stainless steel knife as the usual type of mechanical peeler was not available. One labourer employed at 7 as. per 8-hour working day could peel about 100 to 125 lb. of potatoes.

In foreign countries, particularly in the U. S. A., mechanical peelers are used for the peeling of potatoes. According to Dr W. V. Cruess of the Fruit Products Division, University of California :* 'A successful type of peeler for this purpose consists of a steel cylinder, about 30 in. in width and about 16 in. in depth, the sides and bottom of which are coated with coarse corborundum crystals which act as abrasive surface. The bottom of the peeler revolves rapidly and rubs the vegetable against the rough surface, thus grating the peels from them. A heavy spray of water washes away the peel. The peeling is not perfect, and a considerable hand-trimming is necessary. A machine approximately of the above dimensions was found to have a capacity of about 50 lb. of potatoes per charge which was peeled in 45 seconds. The loss in the peeler was about 36 per cent and in trimming about 2 to 3 per cent.'

Due to present war conditions it may not be possible to import such a peeler, but knowing its working principles as described above, a manufacturer with the aid of an engineer should have no difficulty in designing a mechanism of this type.

Peeling by hand is no doubt a laborious and slow method, but it has one obvious advantage in that the wastage is considerably lower, being about 19 per cent as against 38 to 39 per cent (including trimming) in the case of the mechanical peeler as given by Cruess.

Stage IV : Slicing.—The prepared tubers are sliced about $\frac{1}{4}$ in. thick in ordinary 'fodder-cutter' type slicers which can be set or adjusted to cut slices of the desired thickness. They may be power-driven or hand-driven according to the output desired.

In this laboratory, a small hand-worked slicer (Fig. 3) was used. It could slice about 200 lb. of tubers in an hour. This slicer was purchased from the U. S. A.† some years back at a cost of about Rs. 70. It is a very simple device and can be manufactured locally at a considerably lower cost. In India, this slicer can be had from Messrs Gardener Juices (India), Lyallpur. For larger outputs a number of such slicers can be used with advantage or a similar type of slicer of a larger size can be designed for working with power.

Stage V : Blanching and Chilling.—Vegetables are generally heated in water or live steam before canning as well as drying, and this treatment is known as 'blanching'. Blanching in water can be better regulated than blanching in steam, although the soluble solids of cut and prepared vegetables are lost in greater quantities in water than in steam.

The potato slices as obtained in Stage IV are put direct into water at 180° to 212°F. or better still they are put in thin layers in small baskets and dipped in water at the above temperature. They are allowed to remain at this temperature for 3 to 5 minutes and then removed. If as a result of the immersion of potatoes the temperature of the water falls lower than 180°F., then the blanching time has to be somewhat increased. If they are over-blanched, the slices are overcooked and become mashy and break during handling. If they are under-blanched, the product becomes dark during drying. For large-scale production, water blanching can be made continuous by the use of a conveyer belt of woven metal passing through a closed tank of water at 180 to 212°F., the speed of the conveyer being regulated so as to allow each lot of slices to remain at the above temperature from 3 to 5 minutes. The slices after blanching are immediately immersed in running cold water in a tank, till they are thoroughly cooled.

Stage VI : Drying or dehydration.—As previously mentioned, potato slices as obtained under Stage V cannot be successfully dried in the sun as the quality of the sun-dried product is very poor ; so the blanched slices are dried in a dehydrater. The slices are spread on screen trays of $\frac{1}{8}$ in. mesh at the rate of 1 to 2 lb. of slices per square foot of the screen tray. For home-scale production they are dehydrated in a home drier at a temperature of 140° to 145°F. For commercial production various types of dehydraters are

* *Commercial Fruit and Vegetable Products*, 1938.

† Messrs Anderson, Barngrover, 20-22, Freemount Street, San Francisco, California, U. S. A.

used. One type of commercial dehydrater which has been found to give excellent results in the U. S. A. is diagrammatically represented in Fig. 2. The details of the construction of this dehydrater are fully explained in the diagram and need not be discussed here. It has been estimated that a tunnel dehydrater of the type given in Fig. 2, 15 ft. in length, 5½ ft. wide and 6 ft. high, will be able to accommodate four trolleys with two stacks of 20 trays on each trolley, i.e. 160 drying trays (2½ ft.×2½ ft.). These trays will be able to hold about 1,400 lb. of prepared potatoes in one charge. It is estimated that two or even three such lots can be dried in 24 hours, thus giving a capacity of about 3,000 to 4,000 lb. of prepared potatoes per 24 hrs., yielding about 600-800 lb. of dried potatoes.

The dehydrater of the dimensions mentioned above is being constructed at the Fruit Products Laboratories, Punjab Agricultural College, Lyallpur, and is estimated to cost about Rs. 3,000. With the installation of such a dehydrater it will be possible to give an exact estimate of its outturn. For the other tunnel types of commercial dehydraters, reference may be made to the bibliography given at the end of the article.

Dehydrated potato slices should be white or very light yellow in colour, translucent, hard and brittle; and while broken between the figures, the edges of the broken pieces should be sharp and flinty.

Stage VII : Packing and storage.—Moisture content in the dried potato slices should be below 8·0 per cent as is the case in practically all the dehydrated vegetables, since higher moisture content causes spoilage during storage. Moisture content may be determined by weighing a given sample—say about 10 gm. (well-ground) in a shallow aluminium or glass dish and drying the same in a vacuum oven for about 12 hours at 70°C. and then calculating the loss in weight.

The dried slices may be packed in paraffined paper cartons if required for local and short-period sales, but when required for distant transport, they may be packed in tin containers of any desired capacity and soldered on top. Friction-top tins may also be used, as they are reasonably resistant to moisture absorption and are inexpensive. Double-seamed sanitary cans are, of course, the best containers for packing, but they are very expensive.

Laboratory observations

In preliminary small-scale experiments, it was observed that potato slices having white creamy colour, on drying, yielded white slices—a very attractive product in appearance. Potatoes with even a slightly yellow-coloured flesh, yielded a yellow product and was unattractive in appearance. During the course of the experiments reported below, the above two types of potatoes were available in the local market, but in these experiments only potatoes with white creamy flesh were used. The experimental lots (Table I) were dehydrated in a home-drier as under :

(*a*) Peeled, boiled or blanched, sliced and dehydrated ; (*b*) Boiled, peeled, sliced and dehydrated ; (*c*) Peeled, sliced, boiled and dehydrated ; (*d*) Peeled, sliced, blanched, sulphured for 2 hours (at 8 lb. per ton of slices) and dehydrated. Time of blanching was varied from 2 to 10 minutes in each case. Peeling was done by hand and slices were cut ¼ in. thick in a hand-worked slicer. The slices were dried in the home-drier at 140° to 145°F. The best results were obtained under (*c*), i.e. when the potatoes were first peeled, sliced and then blanched. In all other cases except (*d*) a good portion of the product became brown or black on drying.

As regards the comparative quality of the sulphured and unsulphured product, the former had no doubt an attractive appearance, but on resoaking was devoid of real characteristic 'potato' flavour and had a peculiar chemical taste and odour imparted to the product. Moreover, during the sulphuring process, the sulphurous acid formed by solution of sulphur dioxide (sulphur fumes) rapidly dissolved the zinc coating of the galvanized iron of the screens, imparting a metallic taste to the dried slices, exposing the iron of the wire screens. Iron further caused the blacking of slices by the reaction of iron salts with the slices. Unsulphured slices (potatoes with white flesh) yielded a very wholesome and attractive product which was free from these

defects. Potatoes with yellow flesh ordinarily yield deep yellow slices, the colour of which even when sulphured did not improve to any appreciable degree. Hence sulphuring in the drying of potatoes is not a very safe recommendation and also not practised in other countries except in the case of potato flour which is used in the baking trade or in the textile industry for sizing and starching purposes in which cases exceptionally white potato starch is needed. The potato slices for this purpose are sulphured on wooden slat conveyer belts (and not on wire-gauze trays) and dried as usual in a dehydrater and then ground to a fine powder.

Period of blanching

As regards the period of blanching, 3 to 5 minutes at 180° to 212°F, was found the most appropriate. Over-blanching rendered the slices too soft, mashy, brittle and yellow. On the other hand under-blanching yielded a product of dark colour.

In the home, ordinary boiling or blanching is done by putting the prepared vegetables in thin muslin cloth and then immersing them in boiling water for the desired period, which varies with different kinds of vegetables. In the case of potatoes, this method did not achieve the desired object of blanching, cooking or boiling. The slices lying in the centre of the bag remained uncooked, with the result that a fair proportion of the slices, when dried later, turned black. Proper blanching was, however, accomplished when the slices, as such, were put in a pan containing boiling water and allowed to remain there for three to five minutes at a temperature of 180° to 212°F. The slices, after draining the water through a sieve, were dried as before in a home-drier. The product thus detained was of excellent quality in every respect.

What the tables show

Finally seven lots of potatoes were obtained from the market and dehydrated by the above method and the data thus collected are given in Table I. These data show the variations in the different samples obtained at different dates from the market, the wastage due to peeling, and the yield of the dried product.

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The tabulated data is briefly summarized below :

1. There is a good deal of variation in the quality, size, other outside characters such as skin, shape, etc. of the various lots dehydrated.

2. Average wastage due to peeling and trimming other undesirable portions (excluding lot No. 3 which had very little peel owing to the potatoes being freshly dug from the ground) is about 19 per cent.

3. Yields of dried slices per 100 lb. of fresh potatoes in 'new' potatoes and 'old' potatoes are :

	Approximate wt. of dried potatoes in lb. per 100 lb. of potatoes	
	Unprepared (i.e. original wt. as received)	Prepared (i.e. after peeling, etc.)
'New' potatoes .	15·0—17·5	18·0—19·0
'Old' potatoes .	17·0—24·0	22·0—29·0

'Old' potatoes give comparatively higher yields than 'new' potatoes. This is so, because the 'new' crop, being fresh from the fields, contains a higher moisture content than the 'old' crop, which loses a good bit of the moisture during storage.

4. Time of drying in a home-drier at 140° to 145°F varied from 9·5 to 11 hours, the 'new' crop taking relatively longer for drying than the old crop.

In all the seven lots given in Table I, the dried slices assumed their normal shape, appearance and flavour after soaking in water for 24 hours.

In order to get an idea of the specifications of dried potato slices, viz. thickness of dried slices, pieces per lb., etc., results of three lots are given in Table II. Out of these, lot No. 3, in which large-sized potatoes were used, was considered to yield a standard product. In this lot, there were 210 pieces to the lb. of dried potatoes and the percentage of broken and small pieces was minimum, i.e. 7·9 per cent. The thickness of freshly cut slices should not be more than ¼ in.; otherwise, with thicker slices the product becomes dirty yellow-brown and is unattractive.

Drying of cauliflowers, onions, etc.

In March 1941, at the instance of the Supply Department (India), some preliminary information regarding the dehydration of vegetables, viz. cauliflowers, onions, carrots and peas was collected. The season of these vegetables was almost at an end with the result that one lot only of the late-season crop of each vegetable could be used for drying in a home-drier. The data thus collected along with the data on potatoes (total of 7 lots) are given in Table III, which gives the treatment prior to drying, temperature of drying, yields of dried vegetables per 100 lb. of unprepared (as received from the market) and prepared (after peeling, trimming, etc.) vegetables and the moisture content of the dried product. It is hoped that these preliminary results will serve a useful purpose. With the installation of the fruit and vegetable dehydrater, as previously pointed out, it will be possible to collect further useful information on the dehydration of these vegetables on a commercial scale. The usual methods of dehydration of cauliflower, carrots, peas and onions as tried in this laboratory are very briefly described below. The method of blanching or cooking and dehydration in the case of these vegetables are the same as for potatoes.

Drying of cauliflowers.—Cauliflower heads are separated, washed and the 'flowers' are broken apart and cut into halves or smaller pieces as desired. They are blanched for 2 to 4 minutes in boiling water (tender 'flowers' will require comparatively less time than tough 'flowers'), rinsed in cold water and dehydrated at a temperature of 135 to 140°F.

Drying of carrots.—Carrots are thoroughly washed in running water, the peel and small rootlets (if any) are removed by lightly scraping the carrots with a stainless steel knife held perpendicularly in one hand. For large-scale production in foreign countries, a mechanical peeler as described for potatoes is used. Carrots are then sliced to $\frac{1}{5}$ in. to $\frac{1}{4}$ in. thick slices in a slicer and blanched in a boiling 2 per cent common salt solution for 2 to 4 minutes. The blanched carrots are then rinsed in cold water and dehydrated at a temperature of 165 to 175°F. Carrots can stand higher drying temperature than other vegetables.

Drying of peas.—Tender peas give a much better dried product than fully mature peas which are usually starchy and have a tendency to become tough and mealy during drying. Peas are separated from the pods either by hand or in pea-shelling machines*. They are blanched in boiling water for 2 to 5 minutes according to the tenderness or otherwise of the peas. The blanched peas (not rinsed in cold water) are spread directly on drying trays and dehydrated at 140 to 145°F and dried till entirely crisp.

Drying of onions.—Onions are trimmed and peeled by hand (thin outer peel is removed) and then cut into very thin slices by means of the slicer illustrated in Fig. 3. Slices thicker than $\frac{1}{8}$th of an inch are liable to case-harden during drying. Sliced onions are then dipped in cold 5 per cent brine (common salt solution) for about five minutes and then dehydrated as usual), preferably at a temperature of 135°F., but the temperature should in no case exceed 140°F. Onions are not blanched like other vegetables, as they stick to the drying trays and are unattractive in appearance. A dip in cold brine reduces their tendency to darken during drying and subsequent storage.

All the samples of dried vegetables obtained by the above methods, on re-soaking assumed their normal appearance and on cooking behaved almost like fresh vegetables. These vegetables are packed and stored just like dried potatoes.

Sun-drying of all the above vegetables was also given a trial last year but the products were found to be rather dark in colour, unattractive and had a poor cooking quality, and they were found to be far inferior to the dehydrated product in every respect.

The authors wish to acknowledge the help rendered by M. Mohd. Ishaq, Senior Research Assistant, in collecting the experimental data given in this article.

* A pea-sheller with a capacity for handling about 120 lb. of pea pods per hour exists in the Fruit Products Laboratory, Lyallpur, and was purchased through Messrs Mather & Platt, Ltd., Calcutta, at a cost of Rs. 900 pre-war price. But its working has not been found entirely satisfactory.

TABLE I.—*Dehydration of potatoes in a home-drier*

In each case potatoes were washed, peeled by hand, sliced and blanched from 3 to 5 minutes in water at 180 to 212°F.

Date of drying	Description of sample	Weight of fresh potatoes (lb.)	Weight of prepared potatoes (lb.)	Wastage due to peeling per cent	Weight of dried potatoes (lb.)	Time of drying at 140—145°F in a home-drier (hrs.)	Weight of dried potatoes in lb. calculated per 100 lb. of potatoes	
							From unprepared as received	Prepared
21 November 1940	'Old' potatoes, elongated form, skin intact, white flesh medium size	40·5	33·5	17·3	9·875	10	24·4	29·5
30 November 1940	Do . .	60·0	48·0	20·0	11·25	10	18·7	23·4
3 December 1940	'New' potatoes, fresh crop, circular shape, thin shipped skin, medium size easy to peel	40·75	37·25	8·6*	7·125	11	17·5	19·1
6 December 1940	'Old' potatoes the same as under (1)	24·0	19·5	18·7	4·625	10	19·3	23·7
19 December 1940	Do . .	84·0	65·5	22·0	14·75	9·5	17·6	22·5
30 January 1941	'New' potatoes, skin intact, oval, large size	40·0	32·5	18·7	6·25	11	15·6	19·2
4 February 1941.	Do . .	20·0	16·5	17·5	3·00	10	15·0	18·2

* Low figure, as potatoes used were freshly dug from the fields and had very little peel on them.

TABLE II.—*Specifications of dried potato slices*

Thickness of freshly cut slices	Wastage due to peeling	Time of drying in a drying box at 140—145°F	Pieces per lb. dried product	Percentage broken and small pieces	Thickness of dried slices
0·25 inches (medium-sized potatoes)	22·0	9½ hours	330	15·0	0·061
0·40 inches (large-sized potatoes) .	18·7	11 hours	130	9·7	0·073
0·25 inches (large-sized potatoes) .	17·5	9 hours	210	7·9	0·061

TABLE III.—*Dehydration of vegetables in a home-drier*

Vegetable	Preparation	Weight of vegetable (lb.)	Weight of prepared vegetable (lb.)	Wastage percentage	Treatment	Temperature of drying Degrees F.	Time taken for drying (hrs.)	Dried weight (lb.)	Percentage moisture in dried vegetables	Approximate yields in lb. of dry per 100 lb. of fresh	
										From unprepared	From prepared
Cauliflowers .	'Flowers' broken apart and cut into halves.	55·5	26	53·15	Blanched 2 minutes in boiling water	130—135	16	1·75	8·10	3·1	6·7
Carrots . .	Peeled sliced (¼ in. thickness)	81	67·25	16·98	Blanched 3 minutes in 2% brine at 190—212°F.	165—175	10	5·0	8·53	6·2	7·4
Peas . .	Shelled cleaned	85	41·75	50·88	Blanched 4 minutes in boiling water	140—145	10	11·0	8·24	12·9	26·3
Onions . .	Dried scales and roots removed. Shredded	81	75	7·41	Dipped in cold 5% brine for 5 minutes	135	12·5	10·8	6·30	13·3	14·4
Potatoes (dried in 7 lots—Table I)	Peeled, sliced (¼ in. thickness)	309·25	252·75	18·27	Blanched for 3 to 5 minutes in water at 180—212°F.	140—145	10·2 (Average of 7 lots)	56·875	8·17	18·4	22·5

NOTE.—Yield, of course, will largely depend upon and show slight variation, according to the quality of vegetables. Vegetables under items 1 to 3 were dried late in the season.

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Principles of Fruit Preservation. By T. N. Morris 1933 (Chapman & Hall Ltd., 11, Henrietta Street, London W. C. 2).

Commercial Dehydration of Fruits and Vegetables. By P. F. Nichols, Ray Powers, etc. (United States Department of Agriculture, Bulletin No. 1335 of 1925). (Reprints obtainable from the authors).

Bulletin No. 404 of 1929. By A. W. Christie and P. F. Nichols (University of California, College of Agricultural Experiment Station, Berkeley, California, U. S. A.).

The Dehydration of Vegetables. By W. V. Cruess and E. M. Mrak, Fruit Products Division, University of California. *Fruit Products Journal* (December 1940) (Reprints obtainable from the authors).

Manufacturers of dehydraters*

Chapman Dehydrater Co., Inc., 12th and D Streets, Modesto.

W. W. Cozzens, 10 Broadway, San Jose.

O. S. Crenshaw, Coyote.

Knipschild Dehydrater Co., St. Helena.

The Oliver Co., 670, Lincoln Ave., San Jose.

Rees Blowpipe Manufacturing Co., 340, Seventh St., San Francisco.

G. B. Ridley, Dehydration Engineer, 255, California St., San Francisco.

R. L. Puccinelli, Los Gatos.

E. L. Younger, Woodland.

* In California, U. S. A.

What the Scientists are doing

FOR I C S PROBATIONERS

DR W. Burns, Agricultural Commissioner with the Government of India, on April 8 and 9 delivered two lectures on agriculture to the I C S probationers on camp at Dehra Dun. The first lecture dealt mainly with the cultivator and his work, the soil, the seed and the system of cultivation. The second lecture dealt with the organization of the Departments of Agriculture, new schemes, agricultural associations, gun clubs, shows and methods of propaganda generally. Dr Burns left in the camp library a selection of useful reference books including bundles of departmental leaflets from all the provinces and some states.

***

TRANSMISSION OF RINDERPEST

RINDERPEST is one of the oldest and worst cattle diseases, which, in India, causes enormous losses every year. Research on the mode of transmission of the disease has been, however, limited, and has given no definite conclusions. Is rinderpest spread by biting insects? An experiment to find out to what extent the disease is transmitted by flies under field conditions, using the fly *Tabanus orientis*, was conducted at the Imperial Veterinary Research Institute, Mukteswar, by H. R. Kapur, M.R.C.V.S. It was observed that, if allowed a full feed of blood, these flies rarely fed again in their lifetime. It took them five to ten minutes to have a complete feed. By disturbing the fly repeatedly during its feed, it could be made to feed on several animals, until it was fully engorged. It was also observed that the actual feeding was evidently painless to the animal, which would mean that in field conditions the fly would enjoy a complete and undisturbed feed.

Over 800 flies were made to feed first on an infected animal and then on a healthy bull susceptible to rinderpest, but the flies were unable to transmit the disease. In another experiment, however, only 54 flies, fed in a similar way on an infected and then on a healthy bull, produced the disease. These results suggest that ordinarily the flies do not transmit rinderpest. In the field there is little likelihood of rinderpest being transmitted through these flies as the chances of an interrupted feed are remote. It was also observed that the rinderpest virus remained virulent in the body of the flies for 30 hours and was inactive at 48 hours.

***

JUTE RESEARCH

IN the Technological Research Laboratories of the Indian Central Jute Committee encouraging progress has been made with the investigations which have been undertaken. Test reports have been sent to the Committee's Jute Specialist, Dacca, for all the Government Farm samples (1938 crop) and all the agricultural samples (1939 crop) grown by the Agricultural Research Laboratories and forwarded for spinning trials.

A range of samples of various qualities of commercial fibre (loose jute and export qualities) has been collected and spinning trials and yarn tests are in progress. This work will show how commercial grading links up with spinning quality, how export qualities dovetail in with loose 'jute' qualities and, if continued each year, how the quality of the crop varies from season to season.

Promising results have been obtained in the work of seeking correlations between measurable characters of the fibre and spinning quality.

A number of instruments necessary in the work of measuring fibre characters have been designed and constructed.

A full range of tests has now been completed on a large number of commercial yarns with the object of obtaining a scale against which to compare the results obtained in laboratory experiments.

In the chemistry department numerous analyses have been made of various qualities of jute with the main object of seeking correlations between chemical composition and spinning quality.

As might be expected, close correlations between spinning quality and chemical composition are not apparent. It is not surprising to find, for example, that variation in strength and fineness, which are very important as regards spinning quality, may occur without any very marked change in chemical composition. Certain broad generalizations are nevertheless possible.

A certain amount of work has been undertaken to see the chemical retting action of various reagents on mechanically extracted fibre. A rough rule governing the efficacy of the retting action of various chemicals is becoming apparent. The best samples of fibre prepared in these treatments will be compared with fibre extracted in the usual way and if no outstanding superiority—for example as regards strength, fineness or freedom from speckiness—can be discovered in the chemically retted fibre it will be an indication that such methods of extraction are not a practical proposition as they must always be more expensive than the normal process.

***

FOWL SPIROCHAETOSIS IN INDIA

DR. B. C. Basu, the author of the note entitled 'Fowl Spirochaetosis in India', which appeared in the November (1940) number of this journal (p. 556), has since made the further observation that *Spirochaeta anserina*, the causative organism of this disease, develops normally in the fowl tick (*Argas persicus*) during the cold months at Mukteswar (altitude 7,500 ft.). During the last winter there was a heavy snowfall, but transmission of the disease occurred freely in fowls even during the cold weather. It has also been observed that a certain amount of mortality was liable to occur shortly after the curative or prophylactic treatment with the arsenical drug called atoxyl, unless special care was taken of the birds during the period of treatment.

What would you like to know?

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section will be reserved for replies to selected letters in cases where it seems that the information might be of general interest.

Q. Can any reader tell us where seed of the fodder plant *kudzu* (*Pueraria thunbergiana*) can be had in India ?*

A : Further information about the *kudzu* vine has come from Mr Rattan Singh, Fodder Specialist, Sirsa, who writes : Rooted cuttings of the *kudzu* vine plant were procured from the Department of Agriculture, Tokyo (Japan) and were planted at the Botanical Sub-station, Sirsa, in 1934. These sprouted and formed very large bulky plants giving out vines profusely. Its behaviour as regards green fooder, both quantity and quality, has been studied. It has never been observed to flower and set seed here. It is propagated from its rooted cuttings, a couple of which can be had from this Sub-station.

I also procured its seed from Japan, but this failed to germinate here.

***

Q : Please tell me how I canget rid of white-ants. They destroy whatever plants I plant and do much damage besides.

A : I suppose you refer to orchard plantations. Recently cleared areas should not be selected for this purpose, as the white-ant trouble will always be serious because of the old shrubs, roots and other woody substances remaining mixed with soil. It is therefore essential that before starting plantation all such material should be thoroughly removed by constant ploughing and other means. However, even if after plantation the white-ant trouble persists, the use of paris green is effective. In the case of young plants the soil from near their base should be removed to a depth of about three inches. After destroying the runways by hand, a little quantity of paris green is blown in the vicinity so that any runway linkages with the parent nest, which may be fairly far away from the point of infestation, are also poisoned and consequently destroyed. The base of the plant should be left exposed to the air for some time.

Painting the bark of trees with a mixture of a weak solution of crude oil emulsion and crude creosote in equal parts will keep off white-ants from attacking from outside. This mixture should not touch green and living tissues.

If white-ants are found to work their way up inside the woody part of the trees, a small quantity of poison dust like paris green should be blown into their galleries through holes bored at various heights above ground by means of an auger. The holes should be subsequently plugged with paraffin wax.

If the above methods do not prove useful, breaking up the soil near the tree and pouring a small quantity of carbon bisulphide on the earth at a distance of about a foot from the trunk, then covering the liquid over with earth, will go a long way to kill white-ants. Carbon bisulphide readily turns into gas which penetrates into subterranean galleries and kills the pest therein. Carbon bisulphide is somewhat dangerous to plant life and very large doses should not be used. Care should be taken in handling this volatile fluid, as it is highly inflammable. No flame should be brought near it and the fumes should not be inhaled as they are poisonous.

Some species of white-ants build mounds above ground. In their case there is no difficulty in locating their nests. They can then be destroyed by breaking open the top of the mounds to expose the galleries and fumigating them with carbon bisulphide or even pouring cheap kerosene oil or boiling water into them and then closing the top with mud.

* See INDIAN FARMING, Vol. II, No. 4, p. 198.

Q : Are ants harmful to lac crops ?

A : Ants are not generally harmful to lac crops as believed by the cultivator, though some species undoubtedly pick up the crawling lac larvæ and the males at the time of their respective swarming and this little amount of damage is of negligible importance. On the other hand, all ants, generally associated with lac insects, are useful as they remove the fæces of the lac insect called honey-dew, which is sweet and sticky, and which otherwise mixed with dust, in the absence of rains, is likely to block up the breathing organs and anal opening of the lac insect, and thus cause death by suffocation. In addition, some of them, especially the big black ant named *Camponotus compressus* and the small red ant *Solenopsis geminata*, help the lac insect by feeding on the larvæ of the enemy moths and also picking up enemies from the scraped lac in godowns.

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Q. I want to start rearing sheep on my land in Lyallpur district as a side show and I want the fullest information. I have seen wonderful sheep-dogs in England but as they cannot stand the Punjab climate I should like to produce a cross with any local breed you recommend.

A : The Lohi breed of sheep is indigenous to your district. It should be improved by careful selection and judicious culling. You should consult the Superintendent, Civil Veterinary Department, Multan, with regard to details and literature. It would be advisable if, before you take up this industry you pay a visit to the Hissar Sheep Farm and obtain first-hand information yourself.

Gaddi dogs are generally kept by Ods and other tribes keeping sheep in the Punjab. They have proved themselves to be the best sheep-dogs, but they cannot stand the heat of the plains. A cross-bred type of dog will, therefore, be more useful. Such a type is kept by sheep-breeders in Bikaner. These are very good sheep-dogs and will probably do well in your district, if given a trial. Undoubtedly inheritance plays a prominent part, but the chief factor which makes an efficient sheep-dog is proper training. In South Africa ordinary dogs of intelligent type are trained and used as sheep-dogs.

POSTGRADUATE COURSES ON ANIMAL AND POULTRY HUSBANDRY

CONTRIBUTED BY THE STAFF

Imperial Veterinary and Agricultural Research Institutes, Izatnagar and New Delhi

THE imparting of instruction to students is no new venture on the part of the central institutes. Thus for a number of years an annual postgraduate class for veterinarians has been held at Mukteswar, while similar courses on agriculture and dairying have been held at the Imperial Agricultural and Imperial Dairy Research Institutes respectively. It has, however, been frequently felt that instruction of wider scope in animal husbandry for specially selected students was required, and this indeed was one of the recommendations made by Dr Norman Wright following his deputation to India in 1936. About five years ago much consideration was given to the necessity of expanding the postgraduate teaching facilities in animal husbandry and of deciding how this could be done in the appropriate research institutes of India without interfering with research as their most important function. Much careful discussion was required at headquarters, the provinces and states had to be consulted, and for various reasons, such as lack of proper staff and facilities at Izatnagar, it was not until a year ago that it was decided to bring the plans into operation.

Review of completed courses

To this end two new courses have been started, an Advanced Course in Animal Husbandry and a Special Poultry Course. These are entirely new and do not overlap any of the previously existing courses. The first session of each of these courses has just been concluded so that the present moment is a fitting one to study impressions and to consider improvements in future courses. For particulars of the syllabuses the reader may be referred to a previous issue of INDIAN FARMING* though for convenience a few facts are repeated here.

Students are selected by the Director of the Imperial Veterinary Research Institute and this is done on as wide a geographical basis as possible. For the Animal Husbandry Course due regard is also given to the fact that agriculturists, veterinarians and dairy students should be chosen in nearly equal numbers; for the Poultry Course, with due regard to the claims of veterinarians who are specially interested in disease control and of science and agriculture graduates whose main interest is in the running of farms and improvement of poultry stocks in their own province or state. The fee was fixed at Rs. 20 per mensem.

Advanced Course in Animal Husbandry

This is open to a limited number of selected agriculture, veterinary and dairying graduates; usually about four from each profession can be taken each year. Most of the students taken during the first course were already in Government employment but a few private students were also included. The main object of the course is to provide for advisory work men with some common background of knowledge, since it has been argued that men of this type would be of more value to the average stockowner in India in connection with the numerous problems of animal well-being with which he is faced than people with more specialized knowledge. On the other hand, every endeavour would be made to avoid turning out men who can be described as 'jacks-of-all-trades'.

One of the major difficulties to be faced was

* Vol. I, No. 9, p. 454.

the arrangement of the tuition in such a way that it might be suitable for students possessing differing basic training and drawn from widely separated parts of the country. Within the limited time available this difficulty had to be solved according to the discretion of individual lecturers. A course in animal husbandry cannot be complete without a working knowledge of raising food and fodder crops for cattle and an understanding of the principles of mixed farming. Such a knowledge is necessary for veterinarians and dairy students while to agriculturists it will be of the nature of a revision course.

The course commenced therefore with the agricultural part. The students assembled at the Agricultural Research Institute at Karnal on 15 July 1940, transferred to the main Institute at New Delhi on 15 October and to the Imperial Veterinary Research Institute, Izatnagar, on 15 November. At the suggestion of the students themselves they proceeded to New Delhi on 15 February 1941 to attend the All-India Cattle Show, the daily lectures proceeding as usual. Arrangements were also made for a week (8 to 15 March) to be spent at the Mukteswar branch of the Imperial Veterinary Research Institute, after which the class dispersed.

Work at Karnal and Delhi

Karnal possesses one of the best mixed and mechanized farms in India and the time was spent in considering general farming operations, e.g. the cultivation and use of fodder crops, irrigation, manures and manuring, mixed farming rotations, silage-making, the use and economics of modern farm implements, control of labour and the keeping of records. On all these subjects lectures were given, as well as on general agriculture, soils and cattle-breeding. There was also practical work on the farm and the students were asked to work out problems (*a*) connected with cattle and (*b*) with crops, and finally to discuss their conclusions among themselves.

During the month at New Delhi the students' thoughts were directed more particularly towards dairy stock management, using for illustration the fine herd of Sahiwals maintained there. In this way such problems as the principles of genetics, calf-rearing, feeding and handling of animals, the preparation of animals for show and the keeping of dairy records could be brought home in a practical way and by daily observation of the stock.

At Izatnagar

At the Imperial Veterinary Research Institute at Izatnagar the class was placed under the charge of one of the younger research officers whose duty it was to maintain liaison between students and the various teachers. This organization was helpful to all concerned and not least to the officer himself. After some preliminary revisional training in chemistry, zoology, physiology and disease control, the class was taken over by the various sections, viz. those of Biological Products, Animal Nutrition and Poultry Research, while as mentioned below certain outside lecturers were called in for special purposes. In the Biological Products Section instruction was given in what may be called 'animal hygiene'. As many despairing veterinary students know, this includes a wide variety of subjects such as selection of cattle farm sites; construction and maintenance of buildings for animals; selection of cattle for various purposes; the general management of farm stock and the special care that is required at certain periods; the elements of breeding, e.g. the oestral cycle, service, pregnancy, parturition, the use of artificial insemination, sterility; and farm sanitation. Work in the Animal Nutrition Section was in a sense more theoretical, though lecturers were requested always to keep practical ends in view. The lectures were concerned with the physiology of digestion and absorption; the constituents of animal foods, including a study of the vitamins and the particular role of minerals in nutrition; the balancing of rations; the dietary requirements of animals in regard to growth, reproduction, lactation, work and wool production; and disorders due to badly balanced or deficient diets. As an accompaniment to these lectures, the students engaged in practical exercises, viz. the more simple determinations of the analytical laboratory on such materials as milk, urine, blood serum, food substances, or they were shown practical demonstrations

of the same. In the Poultry Research Section the students followed in part the instruction given to the Special Poultry class. Instruction in animal genetics is also for the present carried out in the Poultry Section; unfortunately in the absence of a section of Animal Genetics the teaching had to be largely theoretical and mainly confined to observations which have been made on the subject in other countries. The lecturer, whenever possible, tried to show how known principles of genetics could be applied to the improvement of stock in India. Looking back, it must be said that the need for a properly trained Geneticist has been acutely felt throughout this course.

The course at Izatnagar was concluded by instruction in special subjects, namely (*a*) the breeding, management and improvement of sheep, (*b*) the production and grading of wool, hides and skins, with attention both to the farming and technological aspects of the subject, (*c*) the defects found in hides and skins with particular reference to damage caused by warble-flies and ticks. This part of the course is supplemented by practical demonstrations at the slaughter house and at hide and skin merchants' godowns, as well as on the shearing of sheep and grading of wool.

Special Poultry Course

This course is open to a limited number of agriculture, veterinary and other graduates specially interested in poultry husbandry. Of ten students attending the first course six were veterinarians and all ten with one exception were already in Government service. The main objects of the course are: (*a*) to provide veterinary graduates with more experience in poultry diseases and practical poultry management so that they will be more fitted for advisory work in the provinces; (*b*) to instruct Government employees in charge of poultry farms and extension work in the technique of experimental procedure and the management of fowls; and (*c*) to equip well-educated young men either for poultry farming on scientific lines or for Government service as poultry specialists.

As in the Animal Husbandry Course, one of the major difficulties in tuition was to provide a course suitable for every one, no matter how wide the differences in their previous basic training. Each lecturer and demonstrator tackled this fundamental problem in his own fashion, and judging by the success of the course it would appear that the various people concerned drew a fairly happy balance between the needs of the different types of students. For instance, some of the veterinary graduates had already done a good deal of routine work in regard to disease investigation, but usually they had little knowledge of the healthy bird, whereas the poultry farm manager type knew more about the healthy bird and its maintenance but knew little about the fundamentals of disease.

The students assembled at the Imperial Veterinary Research Institute, Mukteswar, on 15 October 1940 and after a month's training they were transferred to the Poultry Research Section at Izatnagar on 15 November and concluded their period of training there on 15 March 1941.

Importance of Poultry Show

On the initiative of the students themselves most of them attended the first Poultry Show held in conjunction with the All-India Cattle Show at New Delhi and there saw selected birds of many breeds. In future courses it is proposed to include the Poultry Show at New Delhi as part of the normal curriculum so that students can gain first-hand experience in judging and also come in contact with poultry enthusiasts from all parts of India. Certain students also visited various prominent farms and institutions during the Christmas vacation and in future courses it may be possible to incorporate an educational tour as part of the normal training.

At Mukteswar the students received lectures on the anatomy and physiology of the fowl, diseases and their control, together with practical work on the anatomy of healthy birds, routine examination of diseased specimens including the preparation of cultures, smears and slides from diseased birds. They also had the opportunity of coming into contact with specialists in many branches of research and their methods of tackling disease problems. The genetics lectures at Izatnagar were in

some ways more valuable for the poultry students than the animal husbandry students, for the poultry students saw a considerable amount of practical material in the way of breeds, crosses and the effects of crossing on egg production and body size.

The poultry management lectures covered practical breeding including the selection and management of breeders, storage and incubation of eggs, brooding, rearing and management of laying stock. Practical work on the farm embraced incubation, brooding, rearing, feeding and management of different classes of stock, culling, judging, sexing, weighing and the keeping of the various technical records required on a well-run experimental plant.

Theoretical and practical instruction was given in regard to egg quality and the factors affecting it, methods of storage and preparation of egg products and the detection of egg faults by candling. A course on poultry nutrition embraced a survey of the physiology of digestion in fowls, theoretical requirements for various factor such as proteins, vitamins and minerals and the practical application of these for various classes of stock. The students also participated in the routine analysis of feeding stuffs.

Weekly debates

A feature of the course at Izatnagar, which has proved of considerable value, is the holding of weekly debate classes. At each of these, a student develops a subject selected by himself or in conjunction with the staff and is expected to answer criticisms raised by his colleagues and by any members of the staff who are able to be present. At these classes the chair is taken by the Director or in his absence by a senior member of the staff. The object is partly the dissemination of knowledge but perhaps still more practice in the art of public speaking before a critical audience.

At the All-India Cattle Show the students entered themselves as two teams of four each for the cattle-judging competition and one team was awarded the third prize. At Mukteswar the class was able to examine the type of cultivation suitable for the hills and also to look round the laboratories of the Mukteswar Institute.

Each student who has satisfactorily completed the course is presented with a certificate to that effect.

Suggestions for future classes

Those taking part—both students and teachers were invited to make recommendations, and although these for the most part still remain to be carefully considered, it is not inopportune to make the following comments:

(*a*) The difficulty of imparting instruction to students with different initial qualifications is one which may have to be faced in a concrete and really satisfactory way, viz. by holding a few classes separately for each group before the students assemble as a single class. Thus for non-agriculturists, classes giving preliminary instruction in crop production, including plant pests and their control, may have to be arranged; for agriculturists, classes in which the elements of animal physiology and hygiene are expounded may similarly have to be called. Further, the programme will probably have to be recast in the light of experience so that the time allotted to some of the subjects is more adequate, undesirable overlapping is avoided, and more facilities provided for practical demonstration.

(*b*) The plea that subjects should be taught in greater detail is one to be considered by the Directors, with due regard to the necessity of avoiding interference with research activities of the institutes.

(*c*) A suggestion that properly accompanied visits to some of the main centres of agricultural and veterinary activity should be organized is one that will have to be considered in the light of expense involved by non-employed students. Already it seems that a week's visit to Mukteswar may become a permanent feature.

(*d*) A proposal that students from the Animal Husbandry and Poultry courses might act as judges' assistants at the All-India Cattle (and Poultry) Show is one that is worthy of examination by the Show Committee, and representations to this effect may be anticipated.

(*e*) It is hoped that in time better library and museum facilities may be made available.

Acknowledgements

The Directors of the Imperial Veterinary and Agricultural Research Institutes desire to place on record their appreciation of the unselfish help which has been rendered by those responsible for the actual teaching. In particular, we would mention the following visiting lecturers who were permitted to give their services :

Mr P. N. Nanda, M.R.C.V.S., Superintendent, Government Cattle Farm, Hissar.

Mr Nasir Ahmad, L.Ag., Marketing Officer, Government of India, New Delhi.

Mr B. N. Soni, B.Sc.(Agri.), Entomological Assistant, Imperial Veterinary Research Institute, Mukteswar.

Last but not least, our thanks are due to the following students who attended and helped towards the successful outcome of the courses :

A. Animal Husbandry Course

Veterinary Graduates

Mr K. Ranganatha Rao, G.M.V.C., Assistant Superintendent, Civil Veterinary Department, and Amritmahal Department, Mysore.

Mr K. Balakrishna Pillay, G.B.V.C., Offg. Assistant Director of Veterinary Services, Central Provinces.

Mr Bertie A. D'Souza, G.M.V.C., Probationary Veterinary Officer, Madras.

Mr Pearey Lal Sharma, G.B.V.C., Veterinary Inspector, In-charge Sheep Breeding Farm, Orai, U. P.

Mr Sher Singh Chaudhri, L.V.P., Veterinary Assistant Surgeon, Government Cattle Farm, Hissar, Punjab.

Mr K. R. Patel, G.B.V.C., Veterinary Asistant Surgeon, Baroda.

Agriculture graduates

Mr A. H. Mohyuddin, B.Sc.(Agri.), Estate Manager, Imperial Veterinary Research Institute, Mukteswar.

Mr Udhobo Patnaik, B.Sc.(Ag.), B.Ed., Development Department, Orissa.

Mr N. C. Ahuja, B.Sc.(Hons.), B.Sc.(Agri.) (Durham), Private candidate from the Punjab.

Mr M. R. Nagaraj Rao, B.Sc.(Ag.), Private candidate from Madras.

Indian Dairy Diploma holders

Mr A. J. Lazarus, I.D.D., Supervisor, In-charge Livestock, Imperial Dairy Institute, Bangalore.

Mr Gian Chand, I.D.D., Private candidate from New Delhi.

Mr Anand P. Gupta, I.D.D., Private candidate from the United Provinces.

B. Special Poultry Course

Mr M. Luqman, B.Ag., Department of Agriculture, H. E. H. the Nizam's Government, Hyderabad-Deccan.

Mr Abdul Hamid Khan, Superintendent, Government Dairy Farm, Nagpur.

Mr Mohammad Wajid Ali, Assistant Lecturer, Bengal Veterinary College, Calcutta.

Mr Afsar Ali Khan, B.Sc., Khawaja Qutab, Bareilly.

Mr D. K. Desai, G.B.V.C., In-charge Veterinary Dispensary, Kalol, North Gujarat.

Mr Hari Krishan Malik, B.Sc.(Agri.), Development Department, Punjab.

Mr S. P. Deshpande, Assistant Veterinary Investigation Officer (Poultry), Bombay.

Mr R. Venkataraman, Veterinary Assistant Surgeon, Madras Veterinary College, Madras.

Mr B. L. Moitra, Inspector, Civil Veterinary Department, Bihar.

Mr Ghulam Sarwar Khan, Veterinary Inspector (Poultry), North-West Frontier Province.

Judging by our first experience and the response from provincial and state departments, we believe we can claim that these courses will fill an important gap in the present facilities for instruction in animal and in poultry husbandry. We can at any rate say that a true endeavour has been made to help these men and to impress them with the fact that they are responsible members of society. In the event of their seeking employment we hope that due weight will be given to the fact that they have satisfactorily attended these advanced courses.

SIND

By T. J. Mirchandani, M.Sc., Ph.D. (Lond.)

Officer-in-charge, Agricultural Research Station, Sakrand

A NEW project, unique of its kind in India, has just been initiated by the Government of Sind, through the Department of Agriculture. The idea is to run a farm of 3,000 to 5,000 acres on strict commercial lines and show to the zemindar to what extent farming pays. The objects of this project may be stated as follows:

(*a*) Demonstration of estate management profitably on modern lines as recommended by the Department of Agriculture.

(*b*) A system of collective farming, consisting of small unit holdings on which persons, both educated and uneducated, could receive training and be ultimately settled on land as peasant proprietors and *haris* respectively.

(*c*) An adequate area for seed farms where pure seeds could be multiplied for distribution among other zemindars at reasonable rates.

'*Nationalizing agriculture*'

The land has just been acquired near Mirpur Sakro, Karachi district, and the initial development of the area has begun. Both rice and dry crops will be grown. The Government also propose to make this farm the centre of rural reconstruction work. A model village will be built for the *haris* and every assistance will be given to them to lead a better and healthier life.

This effort, which some newspapers have even called 'nationalizing agriculture', will no doubt be watched with special interest, not only in Sind but throughout India. Questions have always been asked to what extent the recommendations of the Department of Agriculture actually benefit the zemindar, and can he, the zemindar, put into practice fully what the Department wants him to do. The state farm will give an answer to all such questions.

This commercial farm is a natural corollary to the propaganda which the Department of Agriculture have been carrying on for the last ten years and more. A short description of the organization for propaganda will enable the reader to understand how the idea of a commercial state farm grew.

Need for propaganda

It is undoubtedly true that the gap between the research station and the cultivator continues to be wide. To bridge this gulf is perhaps the most important function of the Department of Agriculture. Sir John Russell also emphasized this in his report, while reviewing the work of the Imperial Council of Agricultural Research. The research carried out at the research station will have value only if the results reach the cultivator. But the cultivator is conservative all over the world and Sind or India is no exception. The need for the right type of propaganda became particularly urgent in Sind due to the fundamental changes in methods of agriculture, resulting from the construction of the Lloyd Barrage canal systems.

At present there are three methods in vogue in Sind, by which efforts are made to carry the results of research to the cultivator. These are: (1) auxiliary farms, (2) demonstration plots on cultivators' lands, and (3) agricultural shows, farmers' weeks, lectures, cinema films, etc.

Auxiliary farms

These are Government farms of 150 to 600 acres, where almost the whole area is cultivated by *haris* on the *batai** system, Government functioning as the zemindar. The farm is divided into holdings of 32 acres each and each holding is given to a *hari* who cultivates it under the guidance of the Department of Agriculture, i.e. he adopts the recommendations of the Department regarding rotation of crops, intensity of cropping, use of pure seed of improved varieties, cultural treatment of

* Share system in which the zemindar and the *hari* share the produce.

the soil, and so on. Each holding gets irrigation water according to the Barrage project. The data of yield and money return are carefully maintained and shown to those interested. Visits of zemindars and farmers are organized so that they can see for themselves what improved farming means.

Demonstration plots

These are small plots, one to four acres in area, laid out on the lands of zemindars in order to demonstrate improved methods of cultivation, use of pure seed, trial of new crops or varieties of crop, effects of green manuring, methods of *kallar* reclamation and the use of the most efficient and time-saving implements. This is carrying the demonstration to the very door of the cultivator because no cultivator can fail to be convinced of the value of the recommendation if he sees a better crop growing side by side with an inferior one. Every year, 800 to 1,000 such plots are grown under the supervision of the Department of Agriculture. The Sind Government forgo assessment on such zemindari plots where there is a certain element of risk in the introduction of a new method or new crop.

Agricultural shows

Shows are organized at the time of *durbars* or local fairs where a large number of cultivators, zemindars and the general public assemble. At these shows exhibitions of seeds and implements, explanation, by means of charts, of the recommendations of the Department of Agriculture and cinema films with lectures are arranged. Further, the publicity section of the Department moves from village to village, explaining to large gatherings how to grow better and healthier crops and look after their cattle.

All these methods of propaganda have been very useful and the general standard of cultivation is steadily going up. Zemindars, however, doubted the value of the work of the Agricultural Department, which, being on a small scale, did not appear to them to be applicable to big estates. One big farm has been therefore sanctioned by the Government of Sind for this commercial venture.

Pure seed supply

No improvement in agriculture can be of permanent value and no propaganda can have lasting effect unless the Department is able to supply and ensure the continued supply of pure seed. The need for this was realized by the Department and a settled policy was initiated for the purpose. In other countries the work of multiplication and distribution of seed is done by private firms and individuals such as seedsmen, nurserymen, etc., while here these essential services have to be rendered by the Agricultural Department. The scheme of seed multiplication is based upon the unit system and consists in growing the seed of each variety in five stages: (1) seed patch, i.e. produce of selfed plants, (2) increase block, (3) field-scale planting, (4) village groups, and (5) district groups. Each stage supplies seed for the succeeding stage in the scheme. In the case of cotton, each unit ultimately aims at supplying sufficient pure seed of each improved variety for 25,000 acres of land and in the case of wheat for 50,000 acres. Any number of units can be operated at a time as required.

The seed patch, i.e. the first stage in the scheme, is under the Botanist to the Government, and it is from here that the seed is sent to the Government auxiliary farms which form the 'increase block' stage in the scheme. This stage is also controlled directly by the Botanist. During the third stage, the crop is grown on the lands of selected zemindars, i.e. 'A' class seed growers; in the fourth stage, the seed is multiplied on lands of 'B' class seed growers, while the last stage is completed in general cultivation. Each stage is fed by the seed from the preceding stage. Thus a continuous stream of pure seed flows every year in the district.

In the case of cotton, special care is taken to ensure the purity of seed. This is achieved by thoroughly roguing the crop till the first three stages are completed and also by ginning the produce of these stages in the Government ginnery where strict supervision is excercised. Even in the fourth stage, when the crop is with the 'B' class growers, the roguing is done wherever necessary and a certificate issued. The produce is ginned by the approved

gin-owners who are under agreement with the Department. The seed obtained is stocked in sealed bags and is sold at a small premium over the market rate.

Continuous supply of pure seed

While the production of pure seed was satisfactorily achieved by the Department, it was noticed that an agency was required for the purchase of seed from registered growers and stock for sale in the next sowing season. In the absence of such an agency, the registered seed growers were unable to retain the stock in their godowns and were obliged to sell their produce at the local market. The Government have from time to time sanctioned large sums of money to purchase the seed, as long as there is no loss in the transaction.

In order to make the seed readily accessible to the cultivator, the Department have established seed depots all over the province at the rate of two per taluka. Thus the cultivator is assured of continuous supply of pure seed, available near at hand and at reasonable price. No service is better appreciated by the cultivator than the supply of pure seed of improved varieties.

Promising wheat strain

This is our major grain crop in Sind and the area under this crop exceeds one million acres. The acreage will increase still more as soon as the cultivator learns to organize his *rabi* sowing programme. The Department of Agriculture in Sind have five established varieties of wheat, suitable for different tracts. These are: CPh 47 for irrigated tracts of North Sind, AT 38 for *bosi** areas of North Sind, HSW 3 for Hyderabad district, Punjab 8A for Left Bank† and Pusa 114 for Karachi district. The first three are Sind wheats, selections of local wheats of the province, while the last two are imported and acclimatized. An imported Punjab wheat, C 591, has recently been introduced after many years of acclimatization and trials. It is an early maturing wheat with good quality grain.

* Land inundated in the *kharif* season and moisture conserved. The *rabi* crop is then grown without further irrigation.

† Nawabshah and Tharparkar districts.

The Department have now evolved a strain which shows great promise. It is obtained by crossing CPh 47 and Pusa 114. The new strain is high-yielding, early-maturing, with small, round, plump, deep, amber-coloured and hard grain. It is dwarf with strong straw and tipped earhead. It escapes rust attack by its earliness and does not lodge because of its strong straw. Though the yield may not be higher (it is certainly not lower) than some of the established strains, it has other desirable characters which commend themselves to the cultivator. Further work on it is going on to improve it still further.

Soybeans

A new crop introduced in the province with the Lloyd Barrage irrigation system is the soybean. Several varieties, obtained from India and abroad, were tried. The foreign varieties were generally big-seeded and early-maturing, but they did not succeed as they were susceptible to white-ant attack, while the small-seeded, late-maturing types did well. The optimum sowing period for these was found to be from the end of June to the beginning of July and the most profitable distance for planting of trailing types, 3 ft. between the rows and 9 ft. between the plants. The late-maturing varieties mature in 5½ to 6 months and give an average yield of 10 md. of seed per acre. The trailing varieties have been tested for fodder production and have been found to give 10,000 lb. of green fodder, taken about three months after sowing, and about 600 lb. of seed was obtained from the second growth. The inoculation, with bacterial cultures, on new lands which have not previously grown soybeans, did not show any advantage. The two varieties found most successful were Mir-John-Hat, a small-seeded erect variety, and a trailing variety, which is a selection from a Pusa variety. This crop, though agriculturally a success, had to be given up as there was no outlet for the produce. Soybean is extensively grown in Manchuria, Japan and China and the grain is considered to be very nutritious. The grain has not, however, found favour in India as the pulses are stated to be equally nutritious.

CATTLE IN COCHIN

By M. Sankara Menon, B.A., B.Ag.
Economic Botanist, Government Central Farm, Trichur

THE cattle census of 1940 in the Cochin state showed a bovine population of 250,832. Of this, 193,784 are oxen and 57,048 are buffaloes. This works out roughly to one animal for every two acres of arable land or one animal for every 5·6 people.

In general the cattle of the state are of a mixed mongrel type, small in size, low in milk, and poor in draught. The average milk yield of the indigenous cows has been estimated to be as low as 3 lb. per day. It is only in the important towns where milk is in great demand that people had been showing some interest in having good animals. Thus we find that the wealthy merchants of Cochin have been importing and maintaining good milking cows got down from Bombay and Karachi. To other important towns like Trichur and Ernakulam there has been a regular stream of milking cows coming in from the neighbouring Coimbatore district through the Pollachi market. The marketing survey conducted in the state shows that every year about 5,000 milking cows including buffaloes are imported from Pollachi alone.

Breeding work

The Government of Cochin has been taking very keen interest in the improvement of cattle, especially during the last two decades. The Department of Agriculture has been carrying on breeding experiments with two recognized breeds of India, namely the Ongole and the Sindhi. These two breeds have been found to thrive under conditions prevailing in the state and a large number of animals of these two breeds have been distributed to the people both as breeding bulls and milking cows. Breeding bulls of these two breeds are stationed at the experimental stations, manure depots, model panchayats, municipalities, and the important rural reconstruction centres. A liberal policy is also followed in giving money grants to private individuals or local institutions for maintaining stud bulls approved by the Agricultural Department for public use. There is also a scheme for stationing stud bulls at a few selected veterinary hospitals. Thus quite a good number of desirable stud bulls are maintained in different parts of the state, but to accelerate the rate of improvement we want much larger numbers. The cows over three years of age are 75,998 in number and at the rate of one bull for 60 cows we want over 1,200 good breeding bulls.

The Veterinary Department is also doing good work in checking the spread of contagious diseases and in the treatment and care of animals. With the recent reorganization of the Department, the number of veterinary hospitals was raised from 9 to 10, and eight new dispensaries were also opened. The number of cases treated during last year at these institutions was 36,212. A vigorous campaign is also conducted for the castration of animals unfit for breeding purposes and the number of castrations conducted by the Department during the last year was as high as 2,156. This paves the way for the elimination of large numbers of undesirable animals that would otherwise become future sires.

ANAMALLAI HILLS ANNUAL CATTLE SHOW

THE ninth show was held on 14 December in good weather and a keenly interested crowd followed the judging. The chief judge was the Pattagar of Palayakottai, famed throughout India as a breeder of Kangayams, and he was ably seconded by Mr Sinna Gounder of Kottur, Pollachi, and Mr Ponnayya, District Veterinary Officer, Coimbatore.

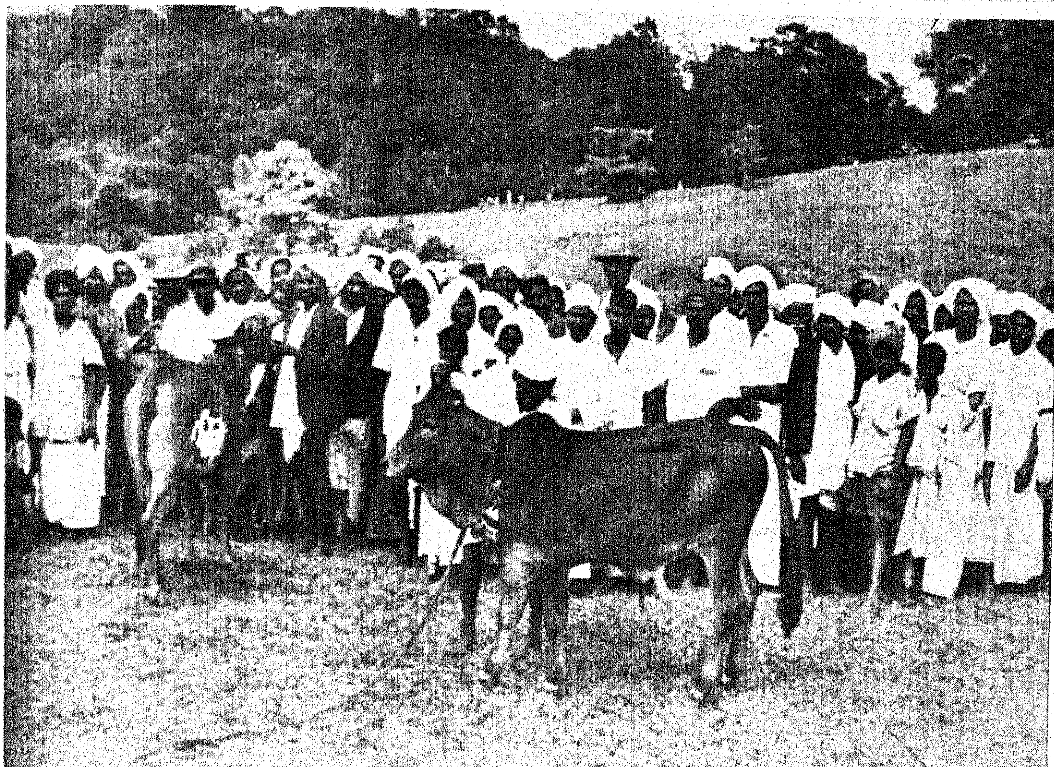
The purpose behind the show is to increase

the milk supply in the Anamallai district on a restricted grazing area. As the estate labour in these hills own about 95 per cent of the 3,000 head of cattle, an increased supply of milk would be of great benefit in their dietary, and incidentally, to their pockets. Years ago the planters in the district realized this and formed the Anamallai Hills Cattle Society with this object in view. A policy was adopted of breeding to pure-bred Sindhi bulls of the best milch strain obtainable, and in this show the result of such a policy was amply demonstrated in the young Sindhi-graded classes which showed good promise. The premier prize was awarded to a young bull bred locally against a strong entry of native bulls (Plate 94).

After a few years of such a policy it is hoped to build up a first class Sindhi herd of pure strain, and then the surplus animals will be available for distribution throughout this part of India.

The Pattagar of Palayakottai gave away the prizes and spoke on the advantages of breeding to this policy. As this was the second time he judged at the show, he was in a strong position to estimate its value and the progress made.

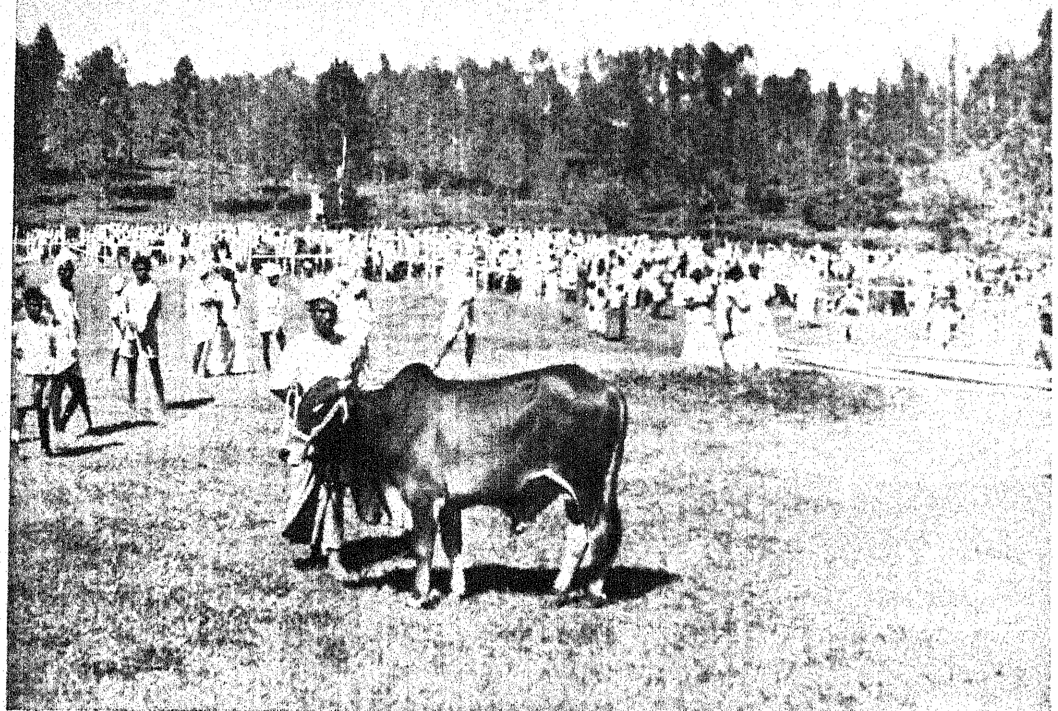
Mr H. Gerry, the President of the Cattle Society, in thanking the judges for their help and advice, rightly reminded his audience that it was because of much voluntary help that they were able to hold their annual show.



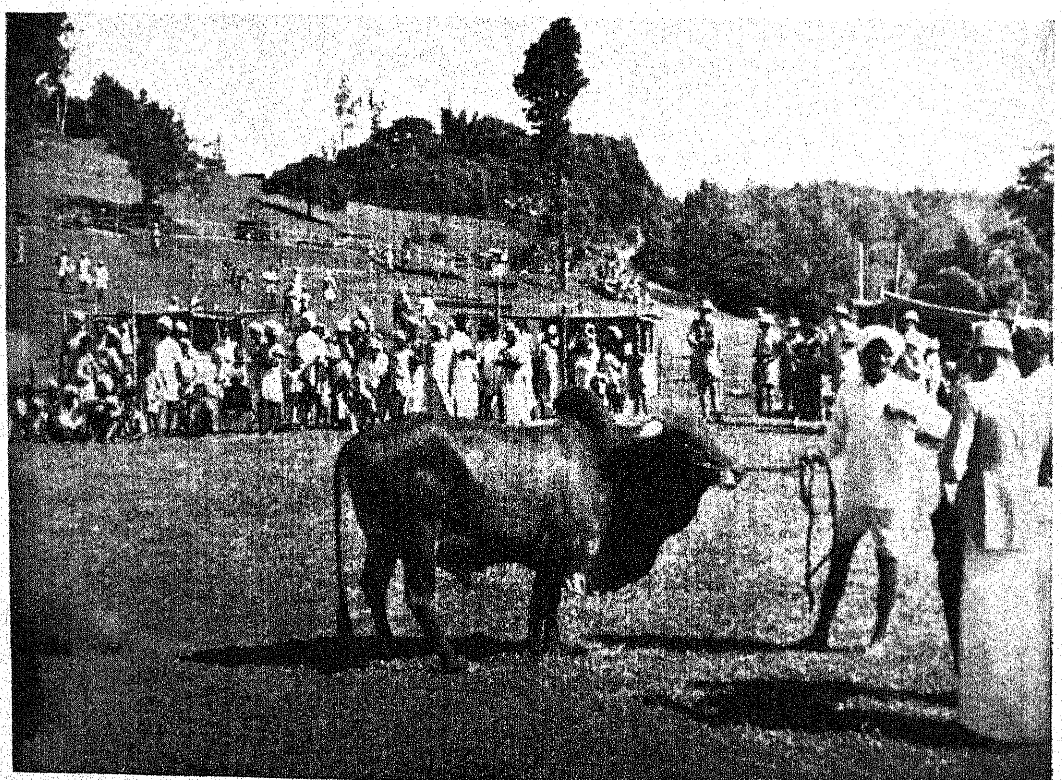
Sindhi bull : champion of the show. Bred in Anamallai. Owner : Ramasamy Maistry, Injipara estate

A nice young heifer—Sindhi-graded

[PLATE 94



A useful young home-bred, Sindhi-graded bull at the Anamallai Cattle show



Imported Sindhi bull at the Anamallai Cattle show

The Month's Clip

SOYBEAN PIONEER*

By Don Wharton

EUGENE Staley hated farming as only a boy could who had whacked at stingy red clay hillsides ever since he could lift a hoe. So at 17 he left his family's North Carolina farm to be a travelling salesman. Curiously, this man who hated farming has done more for the American farmer than almost any other man alive, and the salesman who spent weary years on the road made his most stupendous sale after he was 50 years old and had put away his sample cases for ever. For Eugene Staley became the great salesman of the soybean.

When he began preaching soybeans to skeptical farmers, there was no place in the United States where a farmer could sell a bushel of them except as seed. Now, 18 years after Staley built America's first processing mill, the soybean is a $100,000,000 annual crop. We grow a third of the world's supply, as much as Manchuria, which long was the only important grower. Soy is the one new crop our farmers have tried in many years that has become of major importance.

Staley learned about soybeans as a child. A missionary home from China gave a few seeds to his father as a curiosity. The 7-year-old boy planted them and the Staley family learned to eat soybeans to eke out a scanty diet.

Then he forgot them for years. He was busy. As a boy he peddled vegetables. Later, on the road, he sold books, flavoring extracts, baking powder and finally starch, which he bought in bulk and packaged for home use. By 1912 he was making his own starch from corn in a plant at Decatur, Illinois. The more corn he could buy nearby, the more money he could save on freight. Trying to think of some means of improving the yield of cornfields, he remembered that soybeans, in addition to being food for man and beasts, enrich the soil by adding nitrogen to it. So now every Sunday afternoon found Staley stopping at Illinois farmhouses to put in a word for the bean. The war caused Illinois land to be 'corned to death', the chinch bug arrived to ruin crops, and farmers began to listen to him. Soybean acreage climbed slowly, a few thousand acres a year.

But still there was no market; farmers raised soy plants for hay, for forage and fertilizer, but the beans themselves could be sold only as seed. No crop of any consequence was possible until someone would buy and process beans. Meanwhile, we were importing 15,000 tons a year of soybean oil, cake and meal.

Staley then sold his starch associates the idea of a soybean mill and in 1921 he really went to work on Illinois farmers. He had salesmen talk to them in the fields, in schoolrooms, in courthouses. He bombarded them with letters, pamphlets, newspaper and farm journal articles. Most important, he guaranteed to buy all the beans they grew. In the fall of 1922, his mill began crushing soybeans to make oil and meal, and by March had handled more than twice as many beans as the state had harvested the year before.

At first the domestic oil and meal merely replaced imports. The oil was used mostly in paints and lacquers, the cake and meal for feed. But Staley built a wider market as he went along. The soybean, at first a sideline incidental to helping his starch factory, became the more important end of the business. Staley worked with seed firms to get better seed, with machinery makers to get cheaper cultivating and harvesting implements, got the Illinois Central Railroad to run a special soybean demonstration train which travelled 2,500 miles and was visited by 34,000 persons.

* As condensed in *The Reader's Digest* from *Forbes*.

By 1924, other processors were operating, and Illinois soybean acreage was ten times that of 1921. Staley and the other crushers gradually persuaded manufacturers of livestock feed to use soybean meal in their formulas. The oil was discovered to be excellent for making oleomargarine and salad dressings. Soon the domestic production had not only replaced imports but had grown to a volume far in excess of our former total consumption.

Uses still are broadening. The soybean is remarkably versatile because essentially it is 40 per cent highly digestible protein and 20 per cent fat, which crushes out as oil. Of the oil produced, 85 per cent now goes into human food products, the rest into paints, lacquers and soaps. About 95 per cent of the meal goes into livestock feed. New products ranging from cocktail crackers to plastic articles, such as the knobs and buttons Henry Ford makes for his cars, appear constantly, but the bulk of the crop is used for food, feed and paint.

There is no sign that the soybean's potential market in the United States is near saturation. The government estimates a 17 per cent acreage increase this year, which means a 100,000,000 bushel harvest. Even without new uses, Staley believes present markets can absorb 150,000,000 to 200,000,000 bushels annually.

In any event, soybeans will probably be one agricultural crop without a surplus for some time to come. When Staley opened his mill he bought beans by the wagonload; in 60 days last fall, five railroads brought 9,400 cars of beans to the four processors in Decatur which has become the soybean capital of America. Staley, now 73 and the largest processor in the industry, could not get enough beans to make all the meal and oil he could sell.

Science and salesmanship have developed in our midwestern states an American soybean belt comparable to the one in Manchuria which Japan took with arms, and the chief credit goes to Eugene Staley. But almost the only public recognition he has had is an honorary degree from a North Carolina college a dozen miles from the garden in which a boy who hated farming grew soybeans two-thirds of a century ago.

A recent Bucharest dispatch reveals that the huge crop of soybeans being grown for Germany in Bessarabia was destined for the manufacture of explosives. Other nations have developed a great variety of uses for the soybean, but it remained for the Germans to extract its essential oils for conversion into explosives. German firms had contracted for the crop of about a million acres, on which $10,000,000 had already been advanced. But now Russia, not too far from famine, gets all of the Bessarabian crop.

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THE CARE OF BULLS

IF properly cared for, bulls may be kept in service over a much longer period than is generally the case. Good breeders should be kept in use as long as possible.

The only true measure of a sire's value is the quality of his offspring, says M. J. McPhail, Superintendent, Dominion Experimental Station, Melfort, Sask. In view of this, farmers and breeders would be well advised to secure proven breeders if possible. In so doing it is frequently possible to trade with a neighbour without the outlay of cash.

It should be remembered that no bull can be trusted, and reasonable precautions should be exercised in order to avoid injury. He should be kept in good strong condition, not too thin and not too fat, and reasonable exercise is necessary. If kept in a barn very much, the feet of any beast will grow long at the toes, and the soles will not be worn down naturally. When this happens lameness results. It is not enough to cut off the ends of the hoof, but the foot should be lifted and the bottom pared down. Neglect of the feet has ruined many bulls.—*Press note, Dominion Department of Agriculture, Canada*

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FERTILITY OF TOBACCO SOILS

'A CHAIN is as strong as its weakest link'; so is a tobacco soil productive only in relation to its many parts and the protection which may be given by the tobacco grower to conserve those parts by sound farming practices, states R. J. Haslam, Dominion Experimental Station, Harrow, Ontario.

Science reveals that the quality of tobacco is largely influenced by the physical condition of the soil. This physical condition as related to productivity may be measured by the presence or absence of humus. When soils are depleted of their normal supply of humus a link in the potential chain of soil productivity is weakened. Humus is known as the basis or essence of soil fertility. It not only furnishes conservation facilities for important plant nutrients but energy media for teeming millions of tiny organisms which are beneficial to plant growth.

Crop rotation, cover crops, crop residues, and barnyard manure supply organic matter to the soil. These are sources of humus that assist in keeping up the fertility and vitality of tobacco soils. Laboratory tests have indicated that the majority of tobacco soils are insufficiently balanced with those minerals found to be important in the growth of plants, particularly tobacco. These low mineral levels are also weak links in the potential chain of productivity and may be readily detected in the tobacco crop under field condition and in the cured leaf.

The results of experiments conducted by the Dominion Experimental Farm Service at Harrow and Delhi, Ontario, point definitely to the fact that the reserve of humus and the level of nutrients in tobacco soils may be seriously depleted by intensive cropping and wrong cultural practices. A loss of this reserve tends to weaken the links in the potential chain of soil productivity.—*Press note, Dominion Department of Agriculture, Canada*

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SOIL DEVELOPMENT

THE soil has been formed through the influence of many factors and many changes are still taking place in it. The climate, the original vegetation on the land, the nature of the geological material from which the soil has formed, drainage, the length of time that a soil has been subjected to its present conditions and the modifying treatments brought about by man are some of the more important factors that govern the development and productivity of the soil. These factors are duly considered by the soil surveys conducted by the Dominion Experimental Farms Service in cooperation with the provinces, says P. C. Stobbe, Field Husbandry Division, Central Experimental Farm, Ottawa.

Climate and vegetation largely control the leaching, acidity and the organic matter of the soil. Leaching and acidity increase with humidity, are less pronounced on grassland than under tree cover and vary with the different tree species. On grassland the organic matter is well decomposed and distributed through the soil, while under forest it tends to accumulate at the surface.

The chemical make-up of the geological parent material of the soil, its ease of weathering and the way it has been deposited all have a bearing on soil fertility. Some soil materials leach more readily than others, while some are deficient in certain plant food elements which are abundant in others.

Poor drainage often causes unfavourable physical and chemical changes in the soil and inhibits the activity of soil micro-organisms which are closely connected with soil fertility. Soil formation is a slow process and the length of time that it has been subjected to the influence of the various factors is closely related to the stage of development of the soil. The natural fertility of the soil may be greatly disturbed by farming methods; a fertile soil may be exhausted and a poor soil built up, depending on the management practices used. *Press note, Dominion Department of Agriculture, Canada*

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HOUSEHOLD FLY

THE common housefly is notorious for the part it plays in spreading dangerous diseases, such as typhoid, infantile, diarrhœa, tuberculosis, cholera, and dysentery. It is a menace to health because it breeds in filth and may pass directly to foodstuffs. Particles of decaying organic matter, bacteria, or other living organisms cling to its hairy legs and body and sticky feet and mouth parts. It is computed that one fly may carry as many as 1,000,000 germs, and that the female housefly may become a great grandmother in

60 days, laying around 2,700 eggs during a lifetime of three months.

Houseflies are particularly dangerous during warm weather from midsummer to fall, when they are most numerous. The most effective method of controlling them consists in eliminating or reducing their breeding places by properly treating or disposing of manure and garbage. In the cities, garbage is an important factor in fly production. Control measures to be fully effective should be organized on a community basis, because one neglected garbage dump or manure heap may infest a whole neighbourhood. Collections of manure should be removed from city stables and disposed of at least twice weekly.

In rural sections, where practicable, the manure should be removed daily and spread thinly on fields where the drying effect of sun and wind will prevent breeding. An alternate method consists of taking advantage of heat produced by fermentation when manure is placed in tightly packed piles. The heat produced by fermentation destroys all fly eggs, larvae, and pupae, except perhaps those close to the surface of the top layer. The application with a watering can or sprayer of a solution of borax consisting of one pound of borax to six gallons of water will destroy any fly stages in the top layer of the packed manure. —*Press note, Dominion Department of Agriculture, Canada*

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TESTED RECIPES

Fruit pickles

FRUIT is becoming increasingly popular as a meat accompaniment. The following tested recipe is recommended by the Consumer Section, Marketing Service, Dominion Department of Agriculture :

Rhubarb Relish

12 stalks rhubarb
1 bunch celery
4 large onions
4 cups brown sugar
1 sweet red pepper
2 cups vinegar
10 cloves
1 stick cinnamon } in a bag
1 teaspoon mixed pickle spice } in a bag
3 tablespoons salt

Chop rhubarb, celery, pepper and onions. Sprinkle with salt. Cover and let stand overnight. Drain thoroughly. Add other ingredients. Cook slowly until thick. Pour into sterilized glasses. Seal while hot.—*Press note, Dominion Department of Agriculture, Canada*

New Books and Reviews

The Virus : Life's Enemy

By Kenneth M. Smith. (Cambridge: At the University Press: London: Cambridge University Press, 1940, pp. 176. 7*s.* 6*d.*)

Ever since Pasteur's classical work showing that organisms do not originate *de novo,* few subjects have aroused greater interest than the nature of viruses, which is still shrouded in mystery. Stanley's pioneer discovery of a protein of high molecular weight possessing the properties of the virus, followed by the work of Bawden and Pirie, who showed that the virus protein belongs to a class of nucleo-proteins, has undoubtedly 'dealt a heavy blow to the vitalistic theory'; nevertheless, a great deal of work on animal viruses is still not fully in accord with this view. In this book Dr Kenneth Smith, who is already well known for his two books on plant viruses, reviews the present state of our knowledge of this fascinating subject and seems to be inclined to the view that the virus is non-living and yet possesses the power of multiplication, a characteristic of life.

The book is divided into two parts. The first part deals with the nature of the virus: the discovery of viruses, how they are studied and what is their nature. Part II discusses the methods of infection, the relationship between viruses and their insect vectors and the action of the virus on the host cells. In this section are also described some of the diseases of man and domesticated animals, of birds, fish, insects, plants and bacteria, thus portraying the essential similarity existing between animal and plant virus diseases. The section closes with a chapter on the methods of prevention and control of virus diseases.

The book is written in a clear, forceful style and is a compendium of much valuable information about viruses. It will be welcomed by both the general reader and the specialist.

[B. N. U.]

Farm Animals : Their Breeding, Growth and Inheritance

By John Hammond, M.A., D.Sc. (Iowa), F.R.S. (Edward Arnold & Co., London, 1940, pp. 199, figs. 114. 14*s.*)

The book is of great value to the practical breeder and also to the student. The writer goes into the process of reproduction of all farm animals and poultry. The method of artificial insemination is fully described. Part II of the book goes into genetics in relation to the practical problems of breeding farm animals and the writer agrees that while the basic principles and theories underlying both plant and animal breeding are the same, their practical application to plants and animals is very different and he states his reasons. The chapter on Mendelian application contains a lot of very interesting and important points which the practical breeder should study carefully. Genetic research has shown that it is 'how the animal breeds rather than how it looks, or how it produces' which is the important thing, and so the 'progeny test' has been evolved, whereby the genetic value of the animal in question is measured by the production records of its offspring. This is important in such products as milk and eggs, which the male does not produce himself but only transmits the capabilities of producing to his female offspring. Grading up, in-breeding, organized cross-breeding, directive breeding, herd and flock books are discussed.

The writer states that the showyard has played a large part in moulding breeds of farm animals in Great Britain and he discusses special problems in breeding for production.

The book is very well illustrated and contains a large number of graphs and a very large list of references.

[R. W. L.]

Rural Uplift in Baroda

By BHIKALAL B. KAPASI, B.A. (available from the author at Sayaji Ganj, Baroda, 1940, pp. 75. 8 As.).

RURAL *Uplift in Baroda*, written and published by Mr Bhikalal B. Kapasi, deals in an effective manner with the various steps taken in Baroda State likely to lead to general improvement. The data given is up-to-date and expresses in a very readable manner what is being done by different development departments in rural uplift. [R. G. A.]

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Mass Uplift, Rural and Urban

By BHIKALAL B. KAPASI, B.A. (available from the author at Sayaji Ganj, Baroda. Anglo-Gujarati Bulletins Nos. 8, 9 and 10, 940, pp. 71, 68 and 66. 8 As. each).

MASS *Uplift*, written and published by Mr Bhikalal B. Kapasi, is a periodical bulletin, printed in English-Gujarati, dealing with the various problems concerned with rural reconstruction. It also includes short articles on economic questions and insurance problems. The production is associated closely with the rural activities in evidence in different parts of India, though as is natural, being published primarily for Gujarat consumption more attention is given to such work in Baroda State. [R. G. A.]

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Krishak Bandhu

By MADANMOHAN PRADHAN (Manager, Government Agricultural Farm, Cuttack, 1939, pp. 356. Rs. 2).

APPROVED by the Textbook Committee for use as a handbook for teachers in north Orissa, this book in Oriya should prove useful also to the general reader as the author has taken special pains to make the book light and interesting and to avoid technical terms.

The book is a comprehensive outline of the agriculture of Orissa. It deals systematically with crops, soils, manures, implements, cultural methods, lac, cattle, poultry and a number of other subjects. There is also a chapter on local agricultural sayings, which should prove interesting.

The book has a Foreword by Mr D. R. Sethi, Director of Agriculture, Bihar.

From All Quarters

FARNHAM HOUSE LABORATORY

OWING to the difficulty of conducting work on the biological control of insect and plant pests from the Laboratory of the Imperial Institute of Entomology at Farnham Royal, Bucks, the headquarters of the work have been transferred, for the duration of the war, to the Dominion Parasite Laboratory at Belleville, Ontario, Canada, where the Canadian Government has provided quarters and facilities for work.

Work on the natural enemies of animal and plant pests can now be undertaken for India, in the temperate, subtropical and tropical regions of the western hemisphere. Entomologists who wish to avail themselves of this opportunity for an extension of their biological control work are asked to communicate with Dr W. R. Thompson, Imperial Parasite Service, Imperial Institute of Entomology, 228 Dundas St., Belleville, Ontario, Canada, giving a detailed statement of their requirements.

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PUNJAB FRUIT DEVELOPMENT

MEMBERSHIP of the Punjab Fruit Development Board, we understand, has a number of privileges which may be of interest to horticulturists in other parts of India. Firstly, members and associates are allowed a concession of 25 per cent on the scheduled rates for pedigree fruit plants of outstanding merit available from the Board's nurseries. Secondly, they are entitled to receive *The Punjab Fruit Journal* in English or Urdu together with special numbers, if any. Thirdly, members can place orders through the Board for various gardening requirements, e.g. tools, manures, packages, etc., at concession rates. Fourthly, they can sell their fruit through the Board, which has its own chain of commission agents throughout the Punjab and outside. Fifthly, free technical advice and practical assistance in matters relating to fruit culture and preservation is available to members. Lastly, as a result of the persistent agitation of the Board the Irrigation Department has agreed to give double *wari* (supply of water) to gardens.

There are 300 members from all walks of life, including retired officials, engineers, doctors, judges, advocates and M. L. As. His Excellency the Governor of the Punjab and the Honourable Minister for Development are patron and vice-patron respectively. The regular membership fee is Rs. 5 per annum, and residents outside the Punjab are enlisted as associates on payment of Rs. 5. The Honorary Secretary is the Fruit Specialist, Punjab, Lyallpur.

MGIPC—M—III-1-27—2-6-41—1,800.

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Original Articles

PLANNING FOR RURAL MARKETING

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THE range of requirements to be met by any planning in the field of rural marketing for the country as a whole is so vast that no scheme can, in practice, comprehend all these diverse needs. At one end of the scale we have the petty peasant or tenant raising some inferior kind of food grain on a tiny plot of land and at the other we have large landlords cultivating huge estates and raising crops on a commercial scale. For the bulk of the agricultural population, however, it would be true to assert that they buy in the dearest market and sell in the cheapest, whereas the aim of every economic organization is to buy in the cheapest and to sell in the dearest market. The individual cultivator is ordinarily unorganized for business purposes and hence the business operations of millions of individuals are carried on by them as isolated units. Naturally, therefore, economic interests that are slightly better organized are able to take advantage of the economic weakness of these individuals and this happens to the operations of supply as well as marketing.

No progress without education

Planning in other fields will affect the place of the individual producer in the economic structure; but it is necessary to draw up a plan which may fit in with the agrarian conditions of today, provided certain adjustments are carried out and some regulatory action taken by the state. Even then, not much progress is possible unless individuals get the necessary rudiments of education which alone can prepare their minds for education in business and for training in organized effort for common aims. The diffusion of general education as the basis for training in business methods and corporate action is an essential requisite of progress in this as in other aspects of national life.

Despite favourable conditions, it is often seen from experience that individuals who appreciate the benefits of organized marketing cannot take advantage of the facilities that may be made available by reason of their indebted condition. An indebted agriculturist is often not a free agent in the matter of selling his produce, and in many parts of the country the village moneylender is also a trader through whom supplies are purchased and produce is sold. Before marketing can be organized it is necessary, therefore, that the burden of debt should be eased. It has to be emphasized, however, that while the individual agriculturist will be freed from the domination of an economically stronger middleman, he will have to subject himself to a certain degree of discipline exercised either by the state or by a voluntary cooperative organization of which he is a member. In modern economic life no progress is possible without organization, and organization postulates discipline and mutual control. Those who refuse to subject themselves to the necessary control may have to forgo the advantages expected to accrue from the organization of marketing.

Problem of transport

Before describing in detail the lines on which machinery for the sale of the agriculturist's produce should be set up it is necessary to refer to two important factors which have a vital bearing on the organization of marketing. The first is the problem of transport. Leaving apart the larger aspects of the question of transport, reference may be made here only to the need for joining up villages by suitable roads with the highways of traffic, especially those that link them up with the nearest local market-places. Notwithstanding the expenditure incurred on roads in recent times, the condition of the